IMPLEMENTATION PLAN

FOR AN

AUTOMATED

GEOGRAPHIC INFORMATION SYSTEM
(GIS)

IN

UTAH BLM

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Selected Alternative

____ Optimum GIS Configuration

XX Preferred GIS Configuration

____ Intermediate GIS Configuration

____ Minimal GIS Configuration

Kent Corson, Acting
Approved by: State Director

1.27.86
Date

1. EXECUTIVE SUMMARY

Full implementation of a Geographic Information System (GIS) in Utah BLM will provide resource managers the capability to analyze and interpret spatial data in a timely, cost effective, and objective manner. A GIS brings together not only the means to greater and more efficient resource management, but also a central data storage area for easy access and/or reuse of the data. Also, interfacing and exchanging spatial data with other agencies having GIS capabilities can increase the amount of available data, promote more effective interagency coordination, and reduce duplication of agency efforts.

The success of any GIS is dependent upon a number of nontechnical factors and how they are dealt with managerially. Critical to the implementation process is an effective organization to plan, guide, and manage the system, including the acquisition, installation, and operation of the hardware and software. Adequate planning, budgets, and manpower are limiting factors requiring the most effective utilization of the resources available.

This plan prescribes the basic organizational structure and the respective areas of responsibility, lists the hardware/software needed for an optimum system, procurement schedule, operational procedures and guidelines; estimates funding requirements; and establishes the tasks needed for implementation of GIS in Utah BLM. Ultimate responsibility for GIS implementation rests with the Information Services Branch Chief along with members of a core team from Cartography, PEC, and Information Services. Additional manpower will be required for support of the system as implementation proceeds. Continuing base funding will be required for several years to provide for the detailed planning and management of the system, initial purchase of the hardware and software, and getting the system in place and operational.

Initial funding will be relatively high in comparison to the immediate benefits; however, over time the benefits will far outweigh the costs. Also, the configuration described in the plan represents the optimum system and can be scaled back if necessary. Several alternatives have been identified. The details are laid out in Section 21-"Alternatives." It is assumed in each alternative that the RMP schedule for implementation will be followed.

The GIS system as configured in all but the minimal GIS configuration is essentially a distributed system, with some local processing capability as well as the necessary hardware to access a central computer located in the State Office. In this manner each office will be able to fully utilize GIS, manipulate and analyze their data and produce outputs as needed. Each office will determine their own data needs and what will be entered into the data base for their purposes. They will also determine when and what updates are necessary to keep the data current. Initially, data entry will be accomplished at the State Office where the equipment and trained personnel can be more effectively utilized. At the time when an individual office has sufficient workload to justify their own data entry equipment, that equipment can be obtained and installed in that office, if appropriate funding is available.

In order to achieve and maintain statewide uniformity and compatibility throughout the system it will be necessary to develop some standards in which the system must operate. These standards will be developed between the time the implementation plan is approved and installation of the computer at the State Office. The standards needing development include cartographic mapping input requirements, project documentation, data base organization and cartographic output requirements.

A schedule for GIS implementation has been developed which corresponds with the RMP schedule, based on a FY86 implementation, so that maximum utility of the system can be realized. Following the RMP schedule has many advantages and benefits. This is the time when the most data is available both in quantity and quality and when the data base can be significantly increased. The greatest benefits can be realized during the RMP process where the analytical capabilities can be effectively used to analyze various alternatives and the resultant impacts on the natural resources. Once the data is input for the RMP it can also be effectively used in the day-to-day activities of project planning, EAs, resource assessments, etc. A schedule of this nature coupled with the restricted budgets does, however, have some disadvantages. Some offices will receive GIS equipment before others and will, therefore, limit certain offices in their use of GIS. It would be desirable for each office to receive GIS capabilities at the same time, however, it is not realistic in a restrictive funding environment.

Costs of implementing a comprehensive statewide GIS system is relatively expensive and will take several years to accomplish given the budgetary restrictions. The real benefits of a GIS, however, will not be fully realized until much of the equipment is in place, the system operational, and the data base built.

The time span of this plan is five years. As GIS implementation proceeds, both the substance and content of this plan will be revised annually based on new technology, budget limitations, and manpower needs. Full implementation of GIS is planned over several years so that equipment purchases, technology transfer, and manpower needs can be coordinated to best fit the needs and limitations of the Utah State BLM organization and anticipated budgetary constraints. The intent is to have GIS fully operational in a centralized mode at the State Office before expanding those capabilities in a decentralized (distributed) mode at the District and Area Offices. Destributed processing is not required, but is included in the plan, because when functioning in concert with the central system it would provide maximum user response. The expansion of capabilities beyond the State Office level is planned to coincide with the Resource Management Planning (RMP) schedule so that the greatest benefit and utility of GIS can be employed in the most effective manner. Digitizing will remain centralized in the State Office at least for several years.

2. TABLE OF CONTENTS

2. TABLE OF CONTENTS (Cont'd)

3. PURPOSE OF DOCUMENT

To provide the strategy for the development of a Geographic Information System within Utah BLM. Issues which are addressed include system description, operational procedures, implementation schedules, workload analysis, staffing needs and funding requirements.

4. INTRODUCTION

The need to access and analyze mapped natural resource data in a timely manner has become critical for those establishing policy, making decisions, and planning management activities. It is undesirable and ineffective to rely on incomplete, inaccurate, or unsupportable data. The concern is how to obtain the data when it is needed in a cost effective manner.

BLM needs natural resource data for four primary reasons: 1) response to various policies, directives, and initiatives, 2) support for regional and local decisions, 3) planning for proper land uses would help to protect and enhance the environment.

The need to acquire and analyze large quantities of natural resource data has led to increased research and development of various methods for handling the data. Information systems that bring together and organize data are one way to: 1) provide timely, cost effective, and objective information, 2) develop and manage programs, and 3) store data for ease of recall.

A Geographic Information System (GIS) can provide the capability to analyze and interpret information for a broad range of applications. It can be used to address significant questions in a variety of critical areas and is a powerful analytical tool capable of handling a vast quantity of data in a timely, effective manner that allows for assessment of various management alternatives. Once entered into the data base, information can be reused for a number of other applications. Reuse of this information provides the opportunity to manage various resource programs more efficiently while at the same time reducing costs.
A GIS is not intended to make decisions. It is a tool the manager uses to help make decisions and leaves a clear, documented, and retraceable path from which those decisions are made.

BACKGROUND

The Bureau's need for GIS capabilities was identified as far back as the 1975 Strategic Plan for Information Systems Management. The Grace Report advocates the use of automation. Reform 88 is a thrust to modernize information systems. The BLM modernization study is to analyze ADP equipment needs. All of these efforts are directed at efficiency in government.

The Director of BLM has made an initial commitment to support GIS. Within Utah, there is commitment to GIS from the State Office management team including the State Director.

GIS in Utah began in late FY1981 with the acquisition of digitizing equipment. Actual work was not started until early FY1983 when we were finally able to access a computer at Denver. The lack of our own computer has hindered our effort since we first acquired our digitizing equipment. In May of 1983 we started our efforts to use the Colorado State Office computer which is the only avenue currently available to implement GIS.

To date, all GIS resource data collection and digitizing has been on a project basis. It started in the Vernal District Office within the Book Cliffs Resource Area in the summer of 1983. Since then work has occurred in Utah County and on several small projects. The State Office is now digitizing resource data on the State (1:500,000 scale) base map and plans to collect and digitize data for the Coal Leasing Round II in Carbon County. The Carbon County effort will be the first truly planned and scheduled GIS work in Utah that goes beyond the "project" concept and hopefully will lead to GIS coverage over most of the State.

5. GOALS OF IMPLEMENTING GIS

The two overall goals of implementing a GIS system in Utah BLM are (A) supporting the decision-making process and (B) increasing the amount of available information.

A. SUPPORT DECISION MAKING PROCESS

1. Provide State Director, Divisions, Districts, and Area Offices with state-of-the-art technical planning capability to analyze data quickly.

Comprehensive planning and management of natural resources requires an extensive data base. Results can be no better than the available data and subsequent analysis; therefore, maintaining an updated data base is essential to an effective GIS.

A GIS would make various analytical techniques available to the Utah BLM which are presently too costly or time consuming to apply on a regular basis with current capabilities. The ability of a GIS system to "model" and analyze "what if" questions greatly assists the manager with review of possible alternatives. Various scenarios can be evaluated for their anticipated impacts on all resources. These automated techniques can create models for a variety of land use proposals, thus assisting managers in the planning process.

Depending on the complexity of the issue and the amount of analysis required, information can be quickly retrieved from the system, analyzed, and presented on short notice.

2. Provide State Director, Divisions, Districts, and Area Offices with accurate information in an immediately usable and understandable form, including statistical summaries and maps at a variety of scales.

Results of analyses can be presented in various statistical and graphic formats including charts, graphs, tables, reports, narratives, maps, and three-dimensional perspectives. These products are direct outputs of the Geographic Information System.

GIS provides the ability to access information based on geographic location which is clearly advantageous because virtually all natural resource data is collected on a site-specific basis. Retrieval of data is generally simplified by giving an individual the option of specifying the geographic boundaries for the required data, thereby automatically retrieving only information which is relevant to the area under consideration.

3. Improve coordination with State, local, and other Federal agencies in the development of Resource Management Plans.

Coordination of planning efforts among various agencies becomes even more critical with the increase in volume and scope of Federal legislation and regulations, budget reductions, and the expanding desire of BLM and other

planning authorities to gain control over the use of their lands. The attempt of the various planning authorities to gain control is further complicated by the complexity of expanding demands and utilization of the land and its resources. The greater capability, objectivity, and flexibility provided by a GIS will reduce this struggle and help people reach a common ground more easily.

4. Promote an efficient exchange of data among agencies.

Consolidation of common data needs will improve the accessibility of this data to all data users, thus increasing the ability of each agency to make better decisions. More effective and efficient means of data storage and retrieval will facilitate greater exchange of agency data. Other agencies currently using the Bureau's GIS software include: USFWS, BIA, USGS, DOE, MMS, SCS, and USFS.

5. Improve efficiency/productivity of staff resource specialists.

The ability to access resource information within specific geographic boundaries and interact with other information in the system greatly adds to the efficiency and productivity of staff resource specialists in their day-to-day activities. Managers and resource specialists can quickly retrieve selected data, interact that data with new or other resource data, make management assessments, test alternatives, and determine courses of action on individual plans, projects, or resources.

B. INCREASE AVAILABLE INFORMATION

1. Provide statewide inventory of the natural and cultural resources, infrastructure, land ownership, land use, etc. in a common exchange format.

Available data will be consolidated and reformatted into a consistent and usable format. Data which currently exists in several documents/locations such as statewide land use, will be collected and entered into the system where it will be centrally located and can be displayed for the entire State. Procedures for updating the data and interfacing with other agency data systems must also be included. Remote sensing technology offers some potential advantages as a mechanism to monitor and update.

Eventually, BLM will know what information (data) exists, its level of credibility, and from where it can be accessed. This should lead to a better knowledge of what data may need to be collected or updated for a given project. GIS is a useful tool for cataloging this information.

2. Improve data consistency and quality.

Part of the reason for conflict between agency plans is the result of inconsistent information. Some of these conflicts would be resolved through mutual access to each agencies data base (exchange of data). Greater access to existing agency plans for all data users would also facilitate interagency coordination.

3. Avoid duplication of agency efforts for data collection storage.

Data needs common to more than one agency are presently maintained separately by each agency. This represents a duplication of agency efforts and a waste of public funds. Interfacing and/or sharing data with other government agencies greatly increases data sources and reduces duplication of efforts in collecting and analyzing the data.

4. Minimize cost of information processing.

The computer is the most powerful tool and the most efficient for handling information. Information stored in the computer, viewed as a central storage mechanism, can be easily and quickly accessed by a number of people from different locations. Easy access to this central storage mechanism not only reduces the cost and physical space of storage, but also capitalizes on the efficiency and speed of the computer to handle the information. Cost of processing information can thus be kept to a minimum.

5. Reduce Need for re-inventory.

Resource information stored in a computer can be easily updated, changed, or added to the data base as new information is collected, allowing BLM to maintain current status of the original inventory data. This greatly reduces the need to re-inventory and provides immediate access to the most current information. This information can be maintained in a central

library (computer) providing a mechanism for the information to be utilized by other users. Multiple use of this information not only promotes cooperation between individuals and agencies, but also reduces duplication of efforts in collecting, storing, and processing information.

Accomplishment of these goals will lead to maximum availability of resource information to State, regional, local, and private entities and other Federal agencies that will support a variety of activities. Further, it should eliminate duplication of effort in collecting, storing, and processing resource data.

6. OBJECTIVES OF IMPLEMENTATION PLAN

This implementation plan covers a 5-year period. As GIS implementation begins and experience is gained, both the substance and content of this plan will need revision to adjust to changing needs. The following specific objectives have been identified during this initial phase of planning and will guide the preparation of the implementation plan.

- Schedule GIS implementation
- Identify alternatives
- Develop organizational strategy
- Identify application areas
- Develop project planning process (baseline structure)
- Develop process for setting priorities (data base) (projects)
- Develop strategy for standards
- Secure funding/budget requirements
- Acquire hardware
- Identify staffing needs
- Identify training needs
- Plan system installation
- Describe software use and maintenance
- Identify potential for interfacing with other systems

7. ISSUES AND OPPORTUNITIES/CONSTRAINTS

1. Management Support

   Opportunity - Grace Report, Reform 88, BLM lead on Interior GIS development
   Opportunity - Initial commitment made by BLM Director, SD
   Constraint - Not endorsed by full management team
   Constraint - Conservative management practices

2. No Identifiable Ownership by Program

   Opportunity - 4410, 4121, 4420 have shown interest
   Opportunity - Potential to shift funding between programs
   Constraint - All benefiting activities do not perceive value of GIS to their program
   Constraint - Static/shrinking cost targets (short term)

3. High Initial Costs (with small initial returns)

   Opportunity - Initial hardware could be leased with option to purchase
   Opportunity - Long term costs are overtaken by benefits
   Opportunity - Offset data base development costs by cooperating with other agencies
   Constraint - Resource programs are in a tight financial situation
   Constraint - The success of initial projects is critical to acceptance

4. Staff/Organizational Adjustments

   Opportunity - Nearby University labor source for additional digitizing
   Opportunity - Have core staff:
   2 digitizers
   1 Remote Sensing/GIS coordinator
   Opportunity - If management agrees, priority could be given to shift funding and FTE ceiling
   Opportunity - Some interest by other State Office organizations (e.g., cartography, planning)
   Opportunity - State Office has flexibility in functional organization
   Constraint - Functional/organizational roles not fully agreed upon
   Constraint - If staffing/organization of GIS is fragmented, success is difficult

5. Change of Standard Operating Procedures (the way we do business)

   Opportunity - More defensible decisions (repeatable, speed, more alternatives, better informed)
   Opportunity - Using other State's hardware allows for a demonstration of GIS
   Constraint - Resistance to change
   Constraint - Implementation time for a comprehensive data base will take several years.

8. GIS APPLICATIONS

An automated GIS is more than a sophisticated filing system for maps. It is most valuable as an analytical tool to assist decision makers. This powerful analytical tool is capable of handling vast quantities of data and provides timely, cost effective, and objective information for decision-making, policy formulation, and for developing and managing programs. The primary function is to support the decision-making efforts by providing a formal process for collecting, storing, analyzing, and disseminating data to resource specialists. Use of a GIS can reduce not only the physical space required to store the data, but also the time spent in entering, updating, cataloging, and retrieving the data. Speed, accuracy, and the ability to analyze large quantities of complex spatial data are the main attributes of GIS technology. Since Geographic Information Systems are designed for referencing and retrieving spatially oriented geographic data, they provide the capability to analyze and interpret information for a broad range of applications. Basically, GIS can be utilized wherever spatially oriented geographic data and analysis of that data are required.

Some of the more important applications of GIS technology in BLM activities and programs are for:

- Land Use Planning (RMP's, EIS's, EA's, Special Projects, Project Plans, etc.)

- Minerals Management (leasing, APD's, KGS determinations, mining plans, plans of operations, etc.)

- Day-to-Day Resource Assessment; Inventory and Resource Data; Updating, Editing, and Adding New Information (Includes - Lands, Minerals, Recreation, Cultural and Historic, Grazing, Soils, Wildlife and other resources).

- Cartography (Particularly map & cartographic outputs that facilitate EIS map production)

9. GIS ANALYSIS CAPABILITIES

Some of the more common analytical capabilities of a GIS system include:

- Calculation of area
- Overlaying and compositing
- Calculation of proximity

Analyses can be complex and may include combinations of one or more of the following capabilities:

- Search - The ability to find features which are of a certain type or size or within a given distance from another feature. The computer has the ability to read an entire file of geographic data and retrieve any required data by location, size attribute, or value. This capability is required to evaluate the impacts of proposed routes on any resource that is crossed.

- Measurement - The ability to measure areas of any feature in any unit (e.g. acres, hectares, square miles, etc.), including perimeter, distance, and direction. Measurement is one of the most frequently performed manipulations.

- Comparison - One of the most powerful capabilities of the GIS. It is used to identify relationships between data. A comparative technique, called "compositing," allows the system to overlay different layers of data to examine areas of coincidence. This also provides the capability to develop a system of conditions, data, and inferences as a mathematical description which simulates real world conditions and projects events that may occur through time or as a result of changes. A model may be developed to evaluate and show the best route for a proposed highway or corridor in terms of dollars and impacts upon the various resources. Modeling can be essential to land use planning decision-making and is often needed in the National Environmental Policy Act (NEPA) process (see "Use of Modeling in the NEPA Process" Appendix 1).

  Most queries on a geographic data base will involve combinations of these components and can range from very simple to very complex.

Other capabilities of a GIS system include:

- Scale Variations - Ability to easily change the scale of many outputs to whatever size the user needs and print multiple copies at the desired scale. Accuracy is dependent upon initial input scale.

- Resolution Variations - Ability to summarize or aggregate detailed categories of data.

- Simple Statistics - The capability to do simple trend analysis (i.e., cross tabulation, descriptive statistics, histograms, correlation) and other statistics.

- Interpolation - The capability to interpolate between known data values for the purpose of establishing isolines, e.g., elevation contour mapping.

- Consideration of more alternatives - The speed and efficiency of GIS allows for flexible consideration of alternatives. Parameters may be changed regarding a particular resource conflict and the result of that change can be quickly analyzed. Concerned parties may meet and propose different alternatives and quickly see how these alternatives affect other resource values. The effect is to increase communication between the various resource interests.

- Three dimensional viewsheds - Three dimensional perspectives can be created to show how a proposed project or alteration will look on the landscape from any given viewpoint or angle. Widely used in Visual Resource Management to assess visual impacts.

- Report generation - The attention given to the map in a GIS should not overshadow the importance of simple graphics and report generation. Although maps might be the most visible item from a GIS, area and volume reports are probably used by the greatest number of people. Graphs and charts include such things as histograms, frequency curves, and scattergrams. Eventually a GIS will be able to produce these products as well as multivariate line and bar graphs. Diagrams can be drawn on mapping devices and are usually of high quality for presentation and reproduction.

Beyond simple program listings, a report generating program can provide the following:

- Summaries of system status (tables of descriptive and locational data, size of data base, statistical output, information on updates)

- Statistical tables

- User guides

- The feedback from the system (the explanatory messages and output)

- Visual display of the information the user is manipulating (for interactive systems)

- Documented analysis and decision-making process

10. USER DATA NEEDS AND WORKLOAD ANALYSIS

The nature of Geographic Information Systems requires the on-line storage of very large volumes of data. GIS data are extensive because they must be spatially defined by coordinate values and also because the data are replicated during some GIS processes. During the analysis process, new maps are created from the master map data, which increases the volume of data to be stored. Plot files, created for the production of output products, also increase data storage requirements. This demands effective management of on-line and archived data storage. Estimating the volume of data is an essential part of determining the size and configuration of the entire GIS system.

To estimate the content and volume of Utah's GIS data base it was first necessary to identify what data would be needed by GIS users. Key State Office program leaders were asked to identify map themes needed for their operations. They reviewed a list of themes developed by the New Mexico and Arizona State Offices. Additional themes identified by the Utah Program leaders are listed in the "other" category. The matrix "Utah Digital Data Base Requirements," Table 1 is the result of this effort. It is not intended that each data layer, identified in the table, be added to the data base unless it is needed for a specific purpose. The table was developed for estimating storage requirements in the event each data layer is needed. It does not preclude the addition of other themes if they are required. Identified in Appendix No. 2 are the individuals who assisted in developing the matrix and the programs for which they provided input.

Based on the map themes identified by the data base requirements matrix a second matrix, Table No. 2, was developed to translate the various map themes into bytes of data to be stored. This was accomplished by estimating the megabytes (MB) per quad and determining the number of 7 1/2' quads which would ultimately be required for each theme.

The number of MB per quad was determined from information provided by the Bureau's GIS experience in New Mexico. In some cases, New Mexico's figures were changed to meet our perception of Utah's requirements. Such changes are identified in the list of assumptions for data base size estimates in Appendix No. 3. For instance, some themes were actually determined to be several separate layers, such as habitat sites for each species. In such cases the MB/quad figures were adjusted accordingly.

The number of quads per theme was based on estimates of the extent and need for specific types of information. Again, the rationale for each theme is identified in the assumptions list (Appendix No. 3). The number of quads in each fiscal year was guided by the acreage associated with the Bureau's planning schedule (see Appendix No. 4) and the occurrence of each theme's subjects in that region of the State. This schedule also assumes initiation of GIS projects, based on the planning schedule, during FY86.

Based on these two matrices (Tables 1 and 2), it is possible to construct the GIS's on-line storage requirements. However, there are many other factors which ultimately will determine system storage requirements. These factors are associated with overall system management, system configuration, and operational procedures.

UTAH DIGITAL DATA BASE REQUIREMENTS

DATA LAYER \ SUBACTIVITY	4111 Oil & Gas Leasing	4121 Coal Leasing	4122 Oil Shale	4113 Geothermal Leasing	4131 Mineral Material	4132 Mining Law Admin.	4133 Mineral Leasing	4134 Uranium	4211 Rights of Way	4212 Lower 48 Lands	4220 Withdrawl P & R	4311 Forestry	4321 Wild H & B	4322 Grazing Mgt.	4331 Hist / Cultural	4332 Wilderness Mgt.	4333 Recreation / VRM	4341 Soil. Water. Air Mgt.	4342 Hazardous Waste	4351 Wild. Habitat Mgt.	4352 Endangered Species	4360 Fire Management	4410 Planning	4420 Data Management	4510/4520 Cad. Survey	4610/4620 Firefighting	2300 Access	4712 Recreation Maint.	4713 Transport. Maint.	4720 Engineering	4740 Law Enforcement	4920 L & M Reimbursable	8100 Range Improvements	Other	
PHYSIOGRAPHIC																																			
Land Forms	X	X	X	X	X	X	X	X	X	X	X	•	•	X		X	X	X	X	X	X	X	X			X	X	X		X	X		X		
Slope	X	X	X	X	X	X	X	X	X	X	X	X	•	X	X	X	X	X	X	X	X	X	X		•	X	X	X		X	X		X		
Aspect	X	X	X	X	X	X	X	X	X	X	X	X	•	X	X	X	X	X	X	X	X	X	X			X	X	X			X		X		
Elevation Contours	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•	X	X	X	X	X	X	X	X		•	X	X	X		X	X		X		
Digital Elev. Model	X	X	X	X	X	X	X	X	X	X	X	•	X	X	X	X	X	X	X	X	X	X	X		•	X	X	X		•	X		X		
Drainage Patterns	X	X	X	X	X	X	X	X	X	X	X		•	X	•	X	X	X	X	X	X	X	X			X	X	X		X	•		X		
CLIMATE																																			
Climatic Trends	•	•	•	X	•	•	•	•						•	X	•	•	X		•	X	•	X										•		
Air Quality Mon.	X	X	X	X	•		X	X				•	•	•		•	•	X	X	•	X	X	X			X									
Weather Monitoring	X	X	X	X	•		X	X	X	X		•	•	•			•	X		•		X	•			X							•		
Growing Season	X	X	X	X	X	X	X	X	X	X		•	X	X		X	•	X		X	X		X				X						X		
Precipitation	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X			X	X	•		X			X		
Wind	X	X	X	X	•		X	X				•	•	X			•	X	X	X	X	X	X			X				•			X		
Temperature	•	•	•	•	•	•	•	•				•	X	X			•	•	•	X	X	X	•			X							X		
Humidity	•	•	•	•	•	•	•	•				•	•	•	•		•			•	•	X	•			X							•		
Photoperiod	•	•	•	•	•	•	•	•				•	•	•		•	X				•		X										•		
Lightning												X	•	•			•				•	X	X			X							•		
BIOTIC																																			
Land Cover	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		•	X	X	X		X			X		
Vegetation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		•	X	X	X		X			X		
Habitat Sites	X	X	X	X	X	X	X	X	X	X	X	•	X	X		•	•	•	•	X	X	X	X				X	X			•		X		
Range Sites									X	X	X	X	X	X		X	X	X	•	X	X	X	X				X	X					X		
Woodland Sites	•	•	•	•	•	•	•	•	X	X	X	X	X	X		•	X	X	•	X	X	•	X		•		X	X					X		
Veg. (Historic)									X	X	X	X	X	X	X			X	•	X	X		X				X						X		
Vertebrates	X	X	X	X	X	•	X	X	X	X	X	X	•	X		•	•		•	X	X	•	X				X	•					•		
Invertebrates									X	X	X	X	•	X		•	•	•	•	X	X		•				X	•					X		
Livestock									X	X	X	•	X	X		X	•	X	•	X	X	•	X				X	X			X		X		
Feral Animals									X	X	X	•	X	X		•	•	X	•	X	X		X				X	•			X		X		
Paleontologic	X	X	X	X	X	X	X	X	X	X	X				X	•	X		•				X				X	X		X	X				
Archaeologic	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		•		X	X		X	X		X		
ABIOTIC																																			
Geologic	X	X	X	X	X	X	X	X	•	•	•		•	•	•	X	X	X	X		X		X					X		X			•		
Geomorphologic	X	X	X	X	X	X	X	X	•	•	•			•	•	•	X	X	X				X				X			X	X		•		
Leasable Minerals	X	X	X	X	X	X	X	X		X	X	•	•	•		•	•		X		•		X								X		•		
Locatable Minerals	X	X	X	X	X	X	X	X		X	X	•	•	•		X	•		X		•		X							X	X		•		
Soils	X	X	X	X	X	X	X	X	X	X	•	X	X	X	X	X	•	X	X		X	•	X				X	X		•			X		
Surface Water	X	X	X	X	X	X	X	X	X	X	•	•	X	X	X	X	X	X	X		X		X			X	X	X		X			X		
Ground Water	X	X	X	X	X	X	X	X	X	X	•	•	X	X		X	•	X	X		X		X				X	X		X			X		
Watershed Condition	•	•	•	•	•	•	•	•	•	•	•	•	X	X	•	•	X	X	X		X	X	X			X	X	X		•			X		

X = Essential   • = Desirable   (blank) = Not needed

UTAH DIGITAL DATA BASE REQUIREMENTS

DATA LAYER / SUBACTIVITY	4111 OIL & GAS LEASING	4121 COAL LEASING	4122 OIL SHALE	4113 GEOTHERMAL LEASING	4131 MINERAL MATERIAL	4132 MINING LAW ADMIN.	4133 MINERAL LEASING	4134 URANIUM	4211 RIGHTS OF WAY	4212 LOWER 48 LANDS	4220 WITHDRAWL P & R	4311 FORESTRY	4321 WILD H & B	4322 GRAZING MGT.	4331 HIST / CULTURAL	4332 WILDERNESS MGT.	4333 RECREATION / VRM	4341 SOIL, WATER, AIR MGT.	4342 HAZARDOUS WASTE	4351 WILD. HABITAT MGT.	4352 ENDANGERED SPECIES	4360 FIRE MANAGEMENT	4410 PLANNING	4420 DATA MANAGEMENT	4510 / 4520 CAD. SURVEY	4610 / 4620 FIREFIGHTING	2300 ACCESS	4712 RECREATION MAINT.	4713 TRANSPORT. MAINT.	4720 ENGINEERING	4740 LAW ENFORCEMENT	4920 L & M REIMBURSABLE	8100 RANGE IMPROVEMENTS	OTHER	
ADMINISTRATIVE																																			
LAND NET	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X		
OWNERSHIP	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X		
CAD. SURVEY PLATS																			X				•												
TRANSP. NETWORK	X	X	X	X	X	•	X	X	X	X	X	X	X	X	X	X	X	X	•	X	X	•	X			X		X	X	X			X		
GOVT. JURISDICTION	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X			X	X	X	X	X	X		X		
LEASE BOUNDARIES	X	X	X	X	X	X	X	X		X	X	X	X	X		X	•	X	X	X	X		X								X		X		
LAND USE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X			X	X	X	•	•	X		X		
RIGHTS OF WAY	X	X	X	X	X	X	X	X	X	X	X	X	X	X		•	X	X	X	X	X		X				X	X	X	X	X		X		
OTHER																																			
FLOOD PLAINS	X	X	X	X	X	•	X	X	X	X	X	•	•	•	•		X	X	X	X	X		X				X	X	•	X			•		
RANGE IMPROVEMENTS	•	•					•		•	X	•	•	X	X	X	X	X	X	X	X	X		X			X	X			X	•		X		
HYDROGRAPHY	X	X	X	X	X	X	X	X	X	X	X	•	X	X	X		X	X	X	X	X		X			X	X			X			X		
TRANSPORTATION	X	X	X	X	X	•	X	X	X	X	X	X	•	•	X	X	X	X	X	•			X		X		X	X	X	X	X				
WILDERNESS	X	X	X	X	X	X	X	X	X	X	X	X	•	X	•	X	X	X	X	•	X		X			X	X	X	X	X	X		X		
UTILITY CORRIDORS	X	X	X	X	X	X	X	X	X	X	X	•			X		X	•	X	•			X			X		X	X	X	X				
OIL / GAS WELLS	X	•	•	•	X	X	X	•	X	X	X	•			X	•	•	•	X	•			•		•	X		•	X	X	X		•		
T & E SPECIES	X	X	X	X	X	X	X	X	X	X	X	X	•	X	•	X			X	X			X			X	X	X	X	X	X				
ROCK - SAND - GRAVEL															X	•	•			•	X		•					•	X	X			X		
G. WATER - FLOW & ELEV.																	X	X	X									X							
DISPOSAL SITES																	•	X									X								
FIRE - VALUE CLASS																X	X	•				X	X			X	X	•							
FIRE - PROBLEM CLASS																X	X	•				X	X			X	X	•							
FIRE - LEV. OF SUPPRES.																X	X					X	X			X	X	•							
FIRE OCCURRENCE												•				X	X	•					X			X	X	•							

X ESSENTIAL   • DESIRABLE   ☐ NOT NEEDED

GIS DATA BASE -- WORKLOAD ANALYSIS NOVEMBER 1984 REVISED MAR 29 1985

QUADSUM

MAP THEME	M8/Q	FY-84 QUADS	FY-84 M8	FY-85 QUADS	FY-85 MB	FY-86 QUADS	FY-86 M8	FY-87 QUADS	FY-87 MB	FY-88 QUADS	FY-88 M8	FY-89 QUADS	FY-89 M8	FY-90 QUADS	FY-90 M8	FUTURE QUADS	FUTURE M8	COMPLETE QUADS	COMPLETE MB
PHYSIOGRAPHIC																			
land forms	0.088	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
slope	0.12	0	0	10	1.2	91	10.92	60	7.2	135	16.2	65	7.8	100	12	839	100.7	1300	156
aspect	0.12	0	0	10	1.2	91	10.92	60	7.2	135	16.2	65	7.8	100	12	839	100.7	1300	156
contours	0.12	0	0	10	1.2	91	10.92	60	7.2	135	16.2	65	7.8	100	12	839	100.7	1300	156
elevation	0.12	602	72.24	42	5.04	91	10.92	60	7.2	135	16.2	65	7.8	100	12	417	50.04	1512	181.44
drainage pattern	0.021	0	0	10	0.21	91	1.911	60	1.26	135	2.835	65	1.365	100	2.1	839	17.62	1300	27.3
other	0	0	0	0	0	0	0	0	0		0		0	0	0	0	0	0	0
SUB-TOTAL	0.589	602	72.24	82	8.85	455	45.59	300	30.06	675	67.64	325	32.57	500	50.1	3773	369.7	6712	676.74
CLIMATIC																			
climatic trends	0.008	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
air quality mon.	0.009	0	0	0	0	30	0.27	10	0.09	15	0.135	5	0.045	10	0.09	180	1.62	250	2.25
weather monitor	0.007	0	0	0	0	30	0.21	10	0.07	15	0.105	5	0.035	10	0.07	930	6.51	1000	7
growing season	0.007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	7	1000	7
precipitation	0.009	0	0	30	0.27	91	0.819	60	0.54	135	1.215	65	0.585	60	0.54	559	5.031	1000	9
wind	0.007	0	0	30	0.21	91	0.637	60	0.42	135	0.945	65	0.455	60	0.42	559	3.913	1000	7
temperature	0.009	0	0	30	0.27	91	0.819	60	0.54	135	1.215	65	0.585	60	0.54	559	5.031	1000	9
humidity	0.009	0	0	10	0.09	91	0.819	60	0.54	135	1.215	65	0.585	60	0.54	879	7.911	1300	11.7
photoperiod	0.008	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lightning	0.029	0	0	0	0	85	2.465	30	0.87	80	2.32	40	1.16	30	0.87	1035	30.02	1300	37.7
other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUB-TOTAL	0.102	0	0	100	0.84	509	6.039	290	3.07	650	7.15	310	3.45	290	3.07	5701	67.03	7850	90.65
BIOTIC																			
land cover	0.12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
vegetation	0.219	0	0	90	19.71	91	19.93	60	13.14	135	29.57	65	14.24	60	13.14	799	175	1300	284.7
hab. sites	0.36	30	10.8	50	18	101	36.36	60	21.6	135	48.6	40	14.4	60	21.6	1036	373	1512	544.32
range sites	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
woodland sites	0.088	0	0	80	7.04	75	6.6	30	2.64	60	5.28	40	3.52	35	3.08	130	11.44	450	39.6
veg (historic)	0.081	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
vertebrates	0.004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
invertebrates	0.004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
livestock	0.007	60	0.42	30	0.21	91	0.637	55	0.385	135	0.945	65	0.455	55	0.385	659	4.613	1150	8.05
feral animals	0.004	30	0.12	30	0.12	80	0.32	60	0.24	135	0.54	30	0.12	60	0.24	25	0.1	450	1.8
paleontologic	0.01	0	0	5	0.05	75	0.75	30	0.3	70	0.7	25	0.25	30	0.3	269	2.69	504	5.04
archaeologic	0.01	0	0	100	1	81	0.81	60	0.6	105	1.05	25	0.25	60	0.6	869	8.69	1300	13
other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUB-TOTAL	0.967	120	11.34	385	46.13	594	65.41	355	38.91	775	86.68	290	33.23	360	39.35	3787	575.5	6666	896.51
ABIOTIC																			
geologic	0.557	30	16.71	60	33.42	91	50.69	60	33.42	135	75.2	65	36.21	60	33.42	1011	563.1	1512	842.184
geomorphologic	0.088	0	0	0	0	101	8.888	60	5.28	135	11.88	65	5.72	60	5.28	1091	96.01	1512	133.056
leasable min.	0.024	30	0.72	30	0.72	86	2.064	45	1.08	120	2.88	65	1.56	45	1.08	1091	26.18	1512	36.288
locatable min.	0.012	30	0.36	50	0.6	81	0.972	50	0.6	70	0.84	65	0.78	50	0.6	1116	13.39	1512	18.144
[illegible]	0.548	100	54.8	40	21.92	101	55.35	30	16.44	135	73.98	65	35.62	35	19.18	894	489.9	1400	767.2
surface water	0.021	20	0.42	80	1.68	101	2.121	60	1.26	135	2.835	65	1.365	60	1.26	991	20.81	1512	31.752
ground water	0.004	0	0	20	0.08	101	0.404	60	0.24	135	0.54	65	0.26	60	0.24	1071	4.284	1512	6.048
watershed cond.	0.088	0	0	80	7.04	101	8.888	60	5.28	135	11.88	65	5.72	60	5.28	499	43.91	1000	88
other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUB-TOTAL	1.342	210	73.01	360	65.46	763	129.4	425	63.6	1000	180	520	87.23	430	66.34	7764	1258	11472	1922.67

GIS DATA BASE -- WORKLOAD ANALYSIS, NOVEMBER 1984, AS REVISED

QUADSUM

		FY-84		FY-85		FY-86		FY-87		FY-88		FY-89		FY-90		FUTURE		COMPLETE	
MAP THEME	MB/Q	QUADS	MB	QUADS	MB	QUADS	MB	QUADS	MB	QUADS	MB	QUADS	MB	QUADS	MB	QUADS	MB	QUADS	MB
ADMINISTRATIVE																			
land net	0.07	130	9.1	5	0.35	101	7.07	60	4.2	135	9.45	65	4.55	60	4.2	956	66.92	1512	105.84
ownership	0.09	130	11.7	5	0.45	101	9.09	60	5.4	135	12.15	65	5.85	60	5.4	956	86.04	1512	136.08
cad. survey plats	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
trans net	0.024	20	0.48	70	1.68	91	2.184	60	1.44	135	3.24	65	1.56	60	1.44	1011	24.26	1512	36.288
gov.jurisdiction	0.06	75	4.5	15	0.9	91	5.46	60	3.6	135	8.1	65	3.9	60	3.6	1011	60.66	1512	90.72
lease boundaries	0.06	0	0	0	0	81	4.86	30	1.8	125	7.5	65	3.9	35	2.1	964	57.84	1300	78
land use	0.02	0	0	20	0.4	122	2.44	60	1.2	135	2.7	65	1.3	60	1.2	838	16.76	1300	26
rights-of-way	0.024	0	0	50	1.2	50	1.2	30	0.72	95	2.28	55	1.32	30	0.72	690	16.56	1000	24
other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUB-TOTAL	0.408	355	25.78	165	4.98	637	32.3	360	18.36	895	45.42	445	22.38	365	18.66	6426	329	9648	496.928
OTHER																			
flood plains	0.03	0	0	80	2.4	20	0.6	5	0.15	20	0.6	10	0.3	5	0.15	160	4.8	300	9
range improvement	0.027	0	0	20	0.54	101	2.727	50	1.35	110	2.97	55	1.485	50	1.35	614	16.58	1000	27
hydrography	0.131	0	0	20	2.62	101	13.23	60	7.86	135	17.69	65	8.515	60	7.86	559	73.23	1000	131
transportation	0.131	0	0	90	11.79	91	11.92	45	5.895	115	15.07	35	4.585	45	5.895	579	75.85	1000	131
wilderness	0.066	0	0	40	2.64	86	5.676	60	3.96	35	2.31	30	1.98	60	3.96	189	12.47	500	33
ity corridors	0.021	0	0	20	0.42	50	1.05	30	0.63	85	1.785	25	0.525	30	0.63	260	5.46	500	10.5
& gas wells	0.01	0	0	80	0.8	15	0.15	5	0.05	50	0.5	40	0.4	5	0.05	1317	13.17	1512	15.12
t & e species	0.1	0	0	80	8	15	1.5	5	0.5	35	3.5	15	1.5	5	0.5	1357	135.7	1512	151.2
rock, sand, gravel	0.03	0	0	40	1.2	91	2.73	30	0.9	70	2.1	40	1.2	35	1.05	694	20.82	1000	30
g.water-flow&elev.	0.03	0	0	20	0.6	101	3.03	60	1.8	135	4.05	65	1.95	60	1.8	1071	32.13	1512	45.36
disposal sites	0.002	0	0	1512	3.024	0	0	0	0	0	0	0	0	0	0	0	0	1512	3.024
fire-value class	0.06	0	0	80	4.8	101	6.06	60	3.6	135	8.1	65	3.9	60	3.6	799	47.94	1300	78
fire-problem class	0.06	0	0	80	4.8	101	6.06	60	3.6	135	8.1	65	3.9	60	3.6	799	47.94	1300	78
fire-levl of suppr	0.06	0	0	80	4.8	101	6.06	60	3.6	135	8.1	65	3.9	60	3.6	799	47.94	1300	78
fire occurrence	0.02	0	0	80	1.6	101	2.02	60	1.2	135	2.7	65	1.3	60	1.2	799	15.98	1300	26
other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUB-TOTAL	0.778	0	0	2322	50.03	1075	62.82	590	35.1	1330	77.57	640	35.44	595	35.25	9996	550	16548	846.204
GRAND TOTAL	4.186	1287	182.4	3414	176.3	4033	341.5	2320	189.1	5325	464.5	2530	214.3	2540	212.8	37447	3149	58896	4929.7
ACCUM TOTAL		1287	182.4	4701	358.7	8734	700.2	11054	889.3	16379	1354	18909	1568	21449	1781	58896	4930		

END

Given the projections for data base growth and a hypothetical FY85 date for system acquisition, the following figures can depict the relationship between data volumes and storage capacity.

TABLE No. 3

DATA STORAGE PROJECTIONS

(Not Adjusted to Operational Factors)
(Storage in MB)

Data	FY84	FY85	FY86	FY87	FY88	FY89	FY90
Data (Not DEM)	110	168	298	160	400	183	165
Data (DEM)	72	9	44	29	65	31	48
Total/Yr	182	177	342	189	465	214	213
Total/ACCUM	182	359	701	890	1,355	1,569	1,782
*Storage							
State Office		540	700	700		700	
Districts				620	620	620	620
Areas				60	60	60	60
Total/Yr		540	700	1,380	680	1,380	680
Total/ACCUM		540	1,240	2,620	3,300	4,680	5,360

However, given the following assumptions about system operations, the figures change significantly:

1) MOSS will retain the polygon architecture for the foreseeable future.
2) At least 250 MB on the S.O. system will be reserved for ADS projects at all times.
3) Generally, ADS data will not be on line except for current ADS projects.
4) Only 50 percent of the available DEM's and DEM-derived data (slope/aspect/contours) will be on line at one time not to exceed 200 quads or 100 MB.
5) The MOSS data "swell" factor will be approximately 5 times the original MOSS data. This includes work maps, cells maps, and plot files.
6) Disk space associated with micros is working space and will not be considered for data base storage requirements.
7) Approximately 100 MB of each D.O. system will be required for system overhead.
8) Approximately 100 MB on the S.O. system will be required for overhead rising to 250 MB by FY87 as other graphic activities, such as computer aided mapping, come on-line.
9) The remaining disk storage will be 80 percent utilized. This assumes an effective repacking operation.

Based on these assumptions, we derive new figures in Table No. 4.

*Storage projections are based on acquisition of initial system during FY85.

TABLE No. 4

DATA STORAGE PROJECTIONS

(Adjusted to Operational Factors)
(Storage in MB)

DATA	FY84	FY85	FY86	FY87	FY88	FY89	FY90
Data (Not DEM)	110.1	167.7	297.8	160.3	399.7	183.1	164.8
No. 5 (5x MOSS)	+440.5	+670.6	+1,191	+641.2	+1,599	+732.4	+659
Not DEM-Adjusted	550.7	838.3	1,489	801.5	1,998	915.5	823.8
Data (DEM)	72.24	8.64	43.68	28.8	64.8	31.2	48
No. 4 (50 percent NTE 100 MB)	-36.12	-4.32	-21.84	-14.4	-32.4	-15.6	-24
DEM-Adjusted	36.12	4.32	21.84	14.4	23.32	0	0
Total/Yr	586.8	842.6	1,511	815.9	2,022	915.5	823.8
Total/Cum	586.8	1,429	2,940	3,756	5,778	6,693	7,517
*STORAGE							
State Office		540	700	700		700	
No. 2 (-250 MB)		-250					
No. 8 (-100 to -250 MB)		-100	-75	-75			
State Office Adjusted		190	625	625		700	
Districts				620	620	620	620
No. 7 (-100 MB - each system)				-100	-100	-100	-100
Districts Adjusted				520	520	520	520
Areas				60	60	60	60
No. 6 (-60 MB - each system)				-60	-60	-60	-60
Areas Adjusted				0	0	0	0
Total/Yr		190	625	1,145	520	1,220	520
No. 9 (only 80 percent effectively used		-38	-125	-229	-104	-244	-104
Total Adjusted		152	500	916	416	976	416
Total/ACCUM		152	652	1,568	1,954	2,960	3,376
DIFFERENCE							
Archived MOSS Data							
Total/Yr.	586.8	690.6	1,011	-100	1,606	-60.5	407.8
Total/ACCUM	586.8	1,277	2,288	2,188	3,794	3,733	4,141

*Storage projections are based on acquisition of initial system during FY85.

It is unlikely that, during the life of this plan, on-line storage will exceed what users desire. Clearly, the management of archived data will be a consideration on both the State and District systems. Users will be forced to make decisions on which maps to archive and which to keep on-line. This will be entirely a user decision. System managers will force the decision by the allocation of limited on-line storage. Preferably, the system software will be available to allow users to both archive and recall data through terminal commands.

The level of archiving activity will impact two operational areas. First, it will require some control or oversight as to what is archived or deleted. This is to assure that needed files are on-line and data files are not inadvertently lost. Oversight is especially needed where user directories are shared by several individuals. Secondly, it will create a considerable workload for the computer operators. The frequent mounting and dismounting of tapes or disk packs could develop into a full time job, especially at the central State Office site.

Fortunately, there is reason to believe that the data storage situation will improve. The Bureau is investigating use of data compaction techniques, especially for cell GIS data. Also, the conversion of MOSS to an ARC/NODE architecture will result in approximately a 40-percent reduction of vector GIS data. At the same time one can reasonably expect that advanced storage technology will produce far more efficient data storage devices. High density magnetic disks or optical (laser) disk technology is likely to be available in a few years. For these reasons, while on-line storage will always be a limiting factor, it is manageable and not as critical as the figures first indicate.

The significance of GIS data volumes is not just the management and storage of data but also data entry. The real workload of GIS is data entry or the digitizing of map data. While the data volume figures represent a mix of data from different sources; purchased (DEM's), digital data from tabular data files, and digitized maps; the largest portion will be from digitized maps. The digitizing workload will be accomplished by a mix of in-house and contract digitizing.

To determine the digitizing workload, it is necessary to make some correlation between our data base size and the effort required to digitize a map. While Utah and several other states have some experience digitizing resource maps, there are no documented figures to reference. Also, one cannot assume a perfect relationship between the time it takes to digitize a quad and the amount of digital data (MB) which result. Nevertheless, a relationship does exist between the size of our data base and the workload required to produce it.

To estimate how many MB are typically digitized in a day we will refer to Utah's ADS digitizing experience. The themes for which Utah is most familiar are land net, ownership, and soils. Based on experience, the following numbers of quads are typically digitized in one day:

TABLE No. 5

DIGITIZING RATE FOR SELECTED THEMES

Theme		No. Quads/Day		No. MB/Quad		No. MB/Day
Land Net	=	4.0	X	.070	=	.280
Ownership	=	2.5	X	.100	=	.250
Soils	=	.5	X	.548	=	.274
						.804 ÷ 3 = .268

The number of quads per day times the MB per quad give a figure for the MB per day. Based on these figures, one derives an average of .268 MB digitized per day per each digitizing operator. Because this is a rough estimate it is justifiable to round this figure to .25 MB per day. This is a more convenient figure to work with and does not imply a precision greater than that which is justified. To produce a more meaningful workload measure, multiply .25 MB times 20 work days for 5.0 MB per workmonth. To determine the digitizing workload it is necessary to consider only the non-DEM data identified in Table No. 3. These annual MB figures when divided by the MB/month or 5.0 MB, yields the estimated number of workmonths necessary to digitize the data base.

TABLE No. 6

DIGITIZING WORKLOAD PROJECTIONS

	FY84	FY85	FY86	FY87	FY88	FY89	FY90
Data (Not DEM)	110	168	298	160	400	183	165
Digitizing Workload (WM's) (Data - 5.0 MB/WM)	22.0	33.5	59.5	32.0	80.0	36.5	33.0
Permanent Digitizing Staff (WM's) @ 10 WM/YR	6.0	20.0	20.0	20.0	20.0	20.0	20.0
Difference (WM's)	16.0	13.5	39.5	12.0	60.0	16.5	13.0
Cost if Excess were contracted @$17.00 per hour	43,520	36,720	107,440	32,640	163,200	44,880	35,360

When the work load capacity of our digitizing staff is subtracted from the total number of workmonths, the difference represents the amount of work to be contracted or the increase required in our in-house staff. If one were to use the current contract hourly rate for digitizing ($17.00 per hour) an estimate can be made of contracted cost.

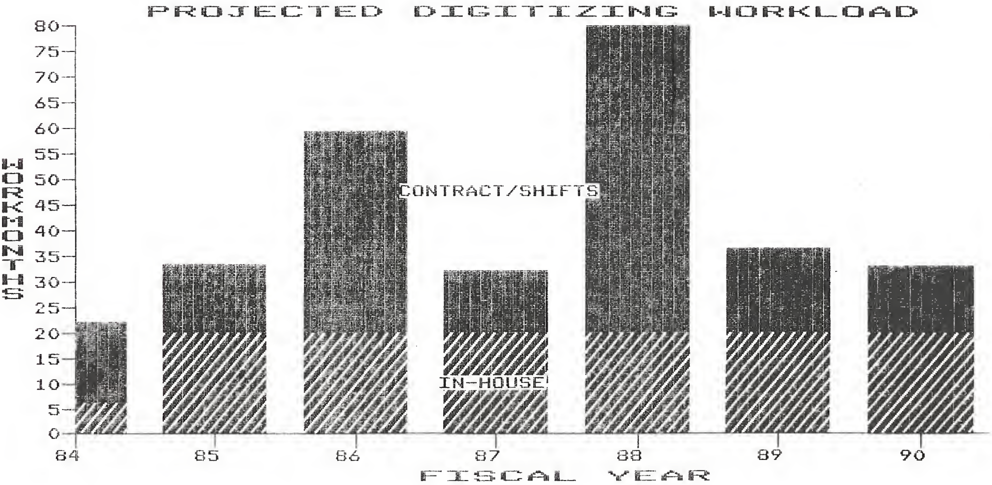
Based on this analysis, it is clear that there is a serious problem in digitizing capacity between FY86 and FY88. This problem should be addressed both by use of contract digitizing and increasing the in-house capacity. The graph in Table No. 7 depicts the relationship between the digitizing workload and in-house capacity, given current staffing. The difference is shown as being contracted. However, because contracting is not expected to be suitable for more than 30 to 50 percent of the total workload, some increase in digitizing staff is required. Looking only at the year with the greatest workload (FY88 = 80.0 WM's) we can determine if the workload is manageable. Assuming that only 30 percent of the work is suitable for contracting, that leaves 56 WM's to be accomplished in-house. There is a third work station available so that another digitizing operator could be hired. That would leave 26 WM work remaining, and this amount could be handled by operating a second eight hour shift on all three work stations. This would be about the maximum production possible; however, the possibility still exists that additional work could be contracted and there might be some production available on the district systems to be installed during that time period. In addition, a fourth work station could be added to the State Office system.

Communication Plan

The large volume of data necessary to represent map images will have a significant impact on Utah's data communications system. In order to transmit these map images in a reasonable time frame, transmission rates of 9600 bits per second (BPS/BAUD) will have to be supported. The reason for this transfer rate is quite obvious. If a typical MOSS output file consists of 300,000 bytes it would take approximately 42 minutes to display this map at the current most commonly used asynchronous transmission rate of 1200 bps. The same map could be transmitted at 21, 10.4, or 5.2 minutes at 2400, 4800, or 9600 bps respectively.

Utah has a comprehensive data communications system planned (BLM Communications Utah-Data Transmission System, April 1983). It proposes extensive use of Bureau and Forest Service microwave links to extend communications to nearly every field office (see BLM Communications Utah-Data System Diagram, Appendix 10). The first circuits of this developing microwave network are already in use in the Moab and Vernal Districts. The recent acquisition of an Infotron 992 network processor is the first major step in implementing the data communications plan. This equipment can support up to 15 high speed composite links each up to 72,000 bps synchronously, and 88 input channels of 9600 bps asynchronously. It can also support synchronous input channels of up to 19,200 bps, dynamic load balancing, and X.25 protocol. It is anticipated that the Utah Data Communication System will support even the heavy demands of GIS for the foreseeable future.

TABLE NO. 7


PROJECTED DIGITIZING WORKLOAD
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
WORKMONTHS
CONTRACT/SHIFTS
IN-HOUSE
84
85
86
87
88
89
90
FISCAL YEAR

11. SYSTEM CAPABILITIES

All existing Bureau GIS applications are operated on the Data General-Eclipse family of computers. Inevitably, this history of experience colors our perception of system capabilities. However, when defining the capabilities of our proposed GIS system we have tried to define them in generic terms as much as possible. In doing so, we are trying to focus on actual performance requirements which are needed and can be related to a variety of available hardware/operating systems. In establishing these requirements, it is inevitable that they are based on observations of the performance of existing GIS systems. It was also assumed that hardware would be dedicated to GIS/Graphics operations. Obviously, if the system were forced to support additional functions, performance would be compromised.

A. Hardware

In discussing hardware requirements, we are looking at three separate central processing units (CPU's) as follows: (1) a large minicomputer (Level A) at the State Office to support nearly all data entry, approximately half the analytical processing and most data output processing: (2) a small minicomputer (Level C) at four district offices to support very limited data entry, most district analytical/processing and some types of output processing; and (3) a large microcomputer (Level D) for local analytical processing at detached area offices. The various Levels A-D originate from planning documents for Bureauwide procurement of graphics computers. There are no plans at this time to purchase level B equipment. The planned interaction between the three types of CPU's presupposes that compatibility in system architecture, operating system and communication protocol will be required.

The system capabilities required of the three levels of CPU's are as follows:

TABLE No. 8

Level	A	C	D
CPU			
BIT Architecture	32 BIT	32 BIT	32 BIT
Multi-Line Comm Processor	Required	Required	Not required
I/O Channel	1.5	1.2	Not required
Pipelined Processor	Required	Required	Not required
Fixed Point Processor	Required	Required	Required
Floating Point Processor	Required	Required	Required
Instruction Set Times			
Add (integer) (n.s.)	500	700	800
Add (floating) (n.s.)	800	2,000	9,000
Multiply (floating) (n.s.)	1,000	5,000	10,000
Machine Cycle Time (n.s.)	150	250	1,000
MIPS	4	1.2	.2
Main Memory			
Maximum Program Size/User	512 KB	512 KB	512 KB
Virtual Address Space	2 GB	1 GB	1 MB
Main Memory (minimum MB)	4 MB	2 MB	1 MB
Main Memory (maximum MB)	16 MB	8 MB	2 MB
Memory Protection	Required	Required	Required
Error Correction/Detection	Required	Required	Required
Minimum Memory Bandwidth (MB/SEC)	28	15	1
Communications			
Communications Processor (Modem/Async)	Required	Required	Not Required
Ports (Modem/Async) (Maximum)	96	48	0
Communications Processor (Local/Async)	Required	Required	Required
Ports (Sync) (Maximum)	8	4	2
Interprocessor Link	Required	Required	Required
Local Area Network	Required	Required	Required

Level	A	C	D
Misc. Hardware Features			
Battery Back-up Available	Not required	Not required	Not required
Bootstrap Loader	Required	Required	Required
Diagnostic Processor	Required	Required	Not required
Real-Time Clock	Required	Required	Required
Peripherals			
Disk Storage			
Fixed Disk (1G)	Required	Not required	Not required
Fixed Disk (350 MB)	Required	Required	Not required
Fixed Disk (30MB)	Not required	Not required	Required
Removable Disk (270MB)	Required	Required	Not required
Floppy Disk (300 KB)	Not required	Not required	Required
On-line Storage Maximum	18 GB	6 GB	70 MB
Tape Storage			
Reel to Reel (1600/ 6250 BPI)	Required	Required	Not required
Reel to Reel (800/ 1600 BPI)	Required	Required	Not required
Cartridge (6250 BPI)	Required	Required	Required
Hard Copy Devices			
Printer (1200 LPM)	Required	Not required	Not required
Printer (600 LPM)	Required	Required	Not required
Printer (300LPM)	Required	Required	Not required
Printer/Terminal (Console)	Required	Required	Required
Video Display Terminals			
Alphanumeric	Required	Required	Required
Graphic (Tektronix Protocol)	Required	Required	Required
Number of Terminals (max)	128	32	4

B. Operating System

BLM's GIS software ADS/MOSS is designed to operate on Data General's AOS or AOS/VS operating system. This is especially true of the ADS software package which is highly operating system dependent. Therefore, any minicomputer which is to be used by BLM for GIS must operate AOS or AOS/VS or the GIS software must be converted to operate on a new operating system. It is assumed that any vendor proposal for graphics equipment which includes an operating system other than AOS/VS will include the cost of converting ADS/MOSS to operate on the new system.

In addition to being compatible with BLM's GIS software, the operating system should be compatible with the operating systems available on smaller minicomputers and microcomputers. This will be necessary if we are to develop a distributed processing system for our GIS operations. Likewise, communication software/protocol should be compatible with the three types of CPU's we plan to install.

C. Software

The Bureau's GIS system is based on the MOSS "family" of software. This family includes compatible data capture, edit, update, retrieval, analysis, output, and data base management systems. It also includes numerous reformatting and data conversion programs.

The MOSS family has grown from the original systems developed by the U.S. Fish and Wildlife Service to also include the Bureau's Automated Digitizing System (ADS) and numerous system enhancements developed by other agencies. The software is currently being used by the BLM, USFWS, BIA, USGS, DOE, MMS, SCS, and USFS.

The MOSS family includes four key subsystems, three of which will be used in the implementation of Utah's GIS system. They are the Automated Digitizing System (ADS) and Analytical Mapping System (AMS) for data entry. BLM Utah plans to use the ADS system for its data entry, the Map Overlay Statistical System (MOSS) for analysis of both vector and cell data, and the Cartographic Output System (COS) for preparation of finished graphic output products. Because these are standard Bureau software systems and involve no discretionary action on Utah's part to be implemented, we are leaving detailed descriptions of the MOSS family software to the system manuals. However, to provide a general understanding of the GIS software we offer the following brief descriptions:

1. Automated Digitizing System (ADS)

The ADS data entry system is an interactive point/vector digitizing system that provides the capability to capture thematic map data as well as other graphic data. ADS supports two-dimensional data base construction by performing a transformation of table digitizer coordinates to map coordinates during the ADS to MOSS conversion function. ADS can capture information in point or stream mode.

Topological formation of polygon areas is performed after the line data have been captured. Labeling map features is conducted interactively by the user after the digital outline of the map has been captured and verified. This sequence increases the speed at which digitizing is conducted. ADS can also be used to assign point and line symbols during the data entry process providing an excellent mechanism for standardizing map symbology. Edge matching between digitized maps is done interactively by the user. Digital map coordinate values are carried as digitizing table coordinates until converted to a map projection for entry to MOSS.

ADS produces pen plotter maps to assist in data entry verification and quality control. ADS can be configured for remote access to a central computer from a local field office using one data communications line making it attractive to offices that require remote data entry facilities.

2. Automated Mapping System (AMS)

The AMS data entry system is an interactive arc/node digitizing system that allows for the capture of spatial data from either maps or aerial photography. AMS provides point, stream, and curve mode digitizing.

The first consideration in AMS is that the data entry latitude/longitude is its locational reference. This enforces a common geographic reference system for the entire data base. Secondly, digitizing occurs in terms of geographic coordinates, rather than table coordinates, ensuring that the new data are immediately referenced to the data base. Thirdly, the geographic data base is subdivided into discrete logical units of fixed size called geounits.

AMS also uses the concept of edge nodes to tie features together that cross geounit boundaries. Data entry personnel are able to perform edge match as an interactive procedure during the initial digitizing process, rather than as a subsequent editing step.

AMS produces pen plotter maps as well as acreage summaries. It also is compatible with the APPS IV analytical stereo plotter - for digitizing directly from aerial photographs. At this time AMS requires more than one data communications circuit for remote use.

There are no plans to implement AMS on Utah's system; however, this decision could be reconsidered in the future.

3. Map Overlay Statistical System (MOSS)

The analysis of geographic data is conducted with the Map Overlay Statistical System (MOSS). MOSS is an interactive or batch mode geoanalysis system designed for the analysis of natural resource information. Functionally, MOSS is utilized by responding to prompts from the system with an English language command and a map identifier. The system executes the initiated command resulting in the generation of map or data base summaries, tabular measurement information, statistical

summaries, text files, interactive measurements of area, distance or location, graphs, plots, interpolated surfaces, and entirely new mapped information derived from user-specified criteria. Over 90 commands are available to perform these functions and can be utilized with a variety of georeferenced data types including text, point, line, polygon, raster, elevation point, and elevation grid. Multiple attributes can be assigned to point, line, polygon, and raster data types. The functions of MOSS commands can be generally classified into five categories: (1) general purpose, (2) data base management, (3) spatial retrieval, (4) data analysis and measurement, and (5) data display.

4. Cartographic Output System (COS)

Although MOSS has display functions capable of plotting to a CRT, line printer, and a variety of plotters, the Cartographic Output System (COS) is most often used to generate final map products. COS is operated from a combination of interactive commands and menus and is based on the concept of generating and positioning data components inside of a graphic profile. Data components consist of entries or groups of entries recognized by the operator as being separate entities in a cartographically sound graphic product such as a legend, scale, or map overlay. The positions of these components are determined in the graphic profile according to operator-specified coordinates. The resulting plotted output can be produced to specific cartographic requirements. COS can be used to produce professional maps of a quality suitable for publication. Unfortunately the Bureau currently does not have the plotting equipment to produce separate color plates readily suitable for printing. However, a centrally located precision plotting device to support all Bureau reproduction could be justified and may someday be available.

12. SYSTEM CONFIGURATION

System configuration refers to the location and functional purpose of specific hardware/software components. Utah's GIS system configuration will be determined by the operational strategy of the GIS program policy. The current strategy is to develop a comprehensive statewide system which will support all field users while maintaining operational compatibility across administrative boundaries. Such a strategy demands a high degree of centralization of data entry and data base management functions. The cost of some components will also dictate that they be centrally located. Although some equipment and management functions will have to be maintained at the State Office, the GIS system, as configured in the optimum through intermediate alternative, is essentially a distributed system.

On the other hand, support to field offices requires some system components to be decentralized. At a minimum, field offices require the equipment to access, manipulate and analyze GIS data and to produce a working quality hard copy. At some point in time, depending on the volume of data being accessed, the type processing being performed, and the frequency of access, it becomes desirable to have a local processing capability at field offices. This desirability is based on both system performance and economies in reducing data communication costs. At such a time, the installation of microcomputers or small minicomputers in field offices should be considered. Distributing data processing functions to satellite units will provide improved response times to field offices while improving the performance of the central system by reducing its workload.

The system configuration outlined in the optimum alternative of this plan is based on a dual strategy of developing both a central system and a distributed processing capability at field offices. The central system will support all users in data base development, specialized processing, and specialized output. The distributed systems will support the local field offices in routine data processing and output. Such an approach should provide the accessibility and response required by field users while maintaining the overall system control and performance capabilities required by all users for effective GIS operation.

The system configuration plan also allows for changes in funding, priorities, and program emphasis. Each year's procurement will consist of equipment which can be used immediately. We won't be acquiring equipment which requires follow-up procurement to be fully utilized. This means we can change the future system configuration or spread out equipment acquisition without being penalized by unused or underutilized hardware. Likewise, State Office and District Office procurement are relatively independent of each other. The plan provides for a logical growth of GIS capability from the State Office to the field, creating a system which can fully stand on its own at any point in time. Section 21-"Alternatives" lists various alternatives considered in implementing GIS within Utah BLM.

The following pages show the optimum plan for acquiring GIS hardware. The plan is divided into two schedules; one for the central State Office system, the second for field office systems. Both systems represent the optimum practical configuration. The two schedules can be pursued independently of each other, with the exception that the field office systems cannot advance beyond the State Office system in the area of communications hardware. The implementation schedules project field office requirements based on their RMP schedule (see Appendix No. 4) and FY85 acquisition of the computer. The plan is dynamic and can be modified to adjust to workload changes.

The information displayed in the fiscal year column shows quantity/cost ($000). Below is a summary of the annual cost for both State Office and field office GIS equipment acquisition.

TABLE No. 10

Summary of Equipment Procurement Costs

	Fiscal Year 0	+1	+2	+3	+4	+5		Total
State Office	348.6	156	154.8	129.2	48.2	0	=	836.8
District Offices	0	52	264.0	275.4	275.4	286.9	=	1,153.7
Total	348.6	208	418.8	404.6	323.6	286.9	=	1,990.5

TABLE No. 11

USO GIS SYSTEM

2/40
2=quantity
40=total cost ($000)

HARDWARE QUANTITIES

Description	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Central Processing Unit									
Level A CPU (w/4MB)	1/158	-	-	-	-	-	1	$158	$158
Level D CPU (W/1MB)	-	1/7	-	-	-	-	1	$ 7	$ 7
Main Memory Increments									
Level A (2MB)	-	2/10	-	2/10	-	-	4	$ 5	$ 20
Disk Storage									
Fixed (350MB)	-	1/25	1/25	-	1/25	-	3	$ 25	$ 75
Add-on (350MB)	-	1/20	1/20	-	1/20	-	3	$ 20	$ 60
Removable (270MB)	1/25	-	-	-	-	-	1	$ 25	$ 25
Add-on (270MB)	1/20	-	-	-	-	-	1	$ 20	$ 20
Fixed (30MB)	-	1/5	-	-	-	-	1	$ 5	$ 5
Tape Storage									
Reel (1600/6250 bpi)	2/80	-	-	-	-	-	2	$ 40	$ 80
Communications									
Modem/async Com. Proc.	1/4	-	-	-	-	-	1	$ 4	$ 4
Modem/async Ports	4/.4	-	4/.4	-	-	-	8	$ 0.1	$ .8
Local/async Com. Proc.	1/4.5	-	-	-	-	-	1	$ 4.5	$ 4.5
Local/async Ports	4/.25	-	-	-	-	-	4	$ .06	$ .25
Synchronous Com. Proc.	-	-	1/4	-	-	-	1	$ 4	$ 4
Synchronous Ports	-	-	4/.4	2/.2	2/.2	-	8	$ .1	$ .8
Hard Copy Devices									
Printer (600 lpm)	1/16	-	-	-	-	-	1	$ 16	$ 16
Printer/terminal	1/3	-	-	-	-	-	1	$ 3	$ 3
Video Display Terminals									
Alphanumeric VDT	2/3	-	-	-	2/3	-	4	$ 1.5	$ 6

TABLE No. 12

USO GIS SYSTEM

SOFTWARE QUANTITIES

Description	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Central Processing Unit									
OS - Vendor Specific	1/10	-	-	-	-	-	1	$ 10	$10
FORTRAN 77	-	1/5	-	-	-	-	1	$ 5	$ 5
X.25 network manager	-	-	1/10	-	-	-	1	$ 10	$10
Data Base Mgmt. System	-	-	-	1/19	-	-	1	$ 19	$19
Sort/Merge	1/.5	-	-	-	-	-	1	$ .5	$ .5
Graphics Kernal System	-	-	1/5	-	-	-	1	$ 5	$ 5
Source Code Debugger	-	1/1	-	-	-	-	1	$ 1	$ 1
Text Control Package	-	1/5	-	-	-	-	1	$ 5	$ 5
Performance Monitor	1/6	-	-	-	-	-	1	$ 6	$ 6

TABLE No. 13

USO GIS SYSTEM

PERIPHERAL QUANTITIES

Description*	0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Special Purpose Processors									
Array Processor	-	-	1/20	-	-	-	1	$20	$ 20
Vector-to-Raster Converter w/disk	-	1/40	-	-	-	-	1	$40	$ 40
Digitizing Tables									
Backlight (40"x60")	-	1/10	-	-	-	-	1	$10	$ 10
Hard Copy Devices									
Color Ink Jet Plotter (8-1/2"x11")	-	1/7	-	-	-	-	1	$ 7	$ 7
Drum Pen Plotter (4-8 pen)	1/18	-	-	-	-	-	1	$18	$ 18
B/W Electro Static Plotter w/Random Elements Processor	-	-	1/70	-	-	-	1	$70	$ 70
Color Electro Static Plotter	-	-	-	1/100	-	-	1	$100	$100
Graphics Terminals									
High Resolution Storage (Tek 4016)	-	1/18	-	-	-	-	1	$18	$ 18
Monochrome Vector	-	2/3	-	-	-	-	2	$ 1.5	$ 3

* The descriptions do not necessarily represent the equipment that would be procured. They merely describe a typical system currently available.

TABLE No. 14

Utah-Districts GIS SYSTEM

HARDWARE QUANTITIES

Description	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Central Processing Unit*									
			Moab	Cedar	Vernal	Richfield			
Level C CPU (W/2MB)	-	-	1/20	1/20	1/20	1/20	4	$ 20	$ 80
Level D CPU (w/1MB)	-	2/14	2/14	2/14	2/14	2/14	10	$ 7	$ 70
		San Raf.		S.L.	Price				
		Dixie	Escal.	Kanab					
Main Memory Increments									
Level C (1MB)	-	-	-	1/5	1/5	2/10	4	$ 5	$ 20
Disk Storage									
Fixed (350MB)	-	-	1/25	1/25	1/25	1/25	4	$ 25	$100
Removable (270MB)	-	-	1/25	1/25	1/25	1/25	4	$ 25	$100
Fixed (30MB)	-	2/10	2/10	2/10	2/10	2/10	10	$ 5	$ 50
Tape Storage									
Reel (800/1600 bpi)	-	-	1/30	1/30	1/30	1/30	4	$ 30	$120
Cartridge (6250 bpi/15MB)	-	2/11	2/11	2/11	2/11	2/11	10	$ 5.5	$ 55
Communications									
Local/async Com. Proc.	-	-	1/4.5	1/4.5	1/4.5	1/4.5	4	$ 4.5	$ 18
Local/async Ports	-	-	4/.25	4/.25	4/.25	4/.25	16	$ .06	$ 1
Synchronous Com. Proc.	-	-	1/4	1/4	1/4	1/4	4	$ 4	$ 16
Synchronous Ports	-	-	2/.2	2/.2	2/.2	2/.2	8	$ .1	$ .8
Hard Copy Devices									
Printer (300 lpm)	-	-	1/12	1/12	1/12	1/12	4	$ 12	$ 48
Printer/terminal	-	-	1/3	1/3	1/3	1/3	4	$ 3	$ 12
Video Display Terminals									
Alphanumeric VDT	-	-	2/3	2/3	2/3	2/3	8	$ 1.5	$ 12

* Offices to receive GIS equipment are based on the current planning schedule. This table assumes a hypothetical FY85 date for acquisition of GIS hardware. The schedule could change depending on District requirements or availability of funds.

TABLE No. 15

Utah-Districts GIS System

SOFTWARE QUANTITIES

Description	0	+1	+2	FISCAL YEAR +3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
OS - vendor specific	-	-	1/10	1/10	1/10	1/10	4	$ 10	$ 40
Fortran 77	-	-	-	1/5	1/5	2/10	4	$ 5	$ 20
X.25 network manager	-	-	1/10	1/10	1/10	1/10	4	$ 10	$ 40
Sort/Merge	-	-	-	1/.5	1/.5	2/1	4	$ .5	$ 2
Graphics Kernal System	-	-	1/5	1/5	1/5	1/5	4	$ 5	$ 20
Source Code Debugger	-	-	-	1/1	1/1	2/2	4	$ 1	$ 4
Text Control Package	-	-	1/5	1/5	1/5	1/5	4	$ 5	$ 20
Performance Monitor	-	-	1/6	1/6	1/6	1/6	4	$ 6	$ 24

TABLE No. 16

Utah-Districts GIS System

PERIPHERAL QUANTITIES

Description*	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Digitizing Tables									
Backlight (40"x60")	-	-	1/10	1/10	1/10	1/10	4	$ 10	$ 40
Hard Copy Devices									
Color Ink Jet Plotter (8-1/2"x11")	-	2/14	2/14	2/14	2/14	2/14	10	$ 7	$ 70
Drum Pen Plotter (4 pen)	-	-	1/18	1/18	1/18	1/18	4	$ 18	$ 72
Graphics Terminals									
High Res. Storage (TEK 4016)	-	-	1/18	1/18	1/18	1/18	4	$ 18	$ 72
Monochrome Vector	-	2/3	4/6	4/6	4/6	4/6	18	$ 1.5	$ 27

* The descriptions do not necessarily represent the equipment that would be procured. They merely describe a typical system currently available.

13. FUNCTIONAL RESPONSIBILITIES AND ORGANIZATIONAL STRUCTURE

On January 18, 1985, State Director Roland Robison made a decision regarding the organization and functional responsibilities for Utah's GIS Program. The decision was a culmination of many meetings, written positions, and an organizational decision document.

Basically, the decision was made to decentralize GIS responsibilities through three State Office Divisions (Lands and Renewable Resources, Operations, and Administration). The decision also contained three important conditions.

1. The Branch Chief, Information Services, will retain the overall responsibility for GIS implementation, including policy and strategies.

2. Those personnel in the participating Divisions which are involved in GIS (one each from Resources, Operations, and Administration) will have their position descriptions changed to reflect the fact that GIS will be their priority function. When not needed for GIS, they may return to their duties in their home organizations, subject to the mutual agreement of the Branch Chief, Information Services, the appropriate Branch Chiefs of PEC and Cartography.

3. This organizational structure will be reviewed in 18 months from date plan is approved to determine if this organization is still appropriate as established. At that time, absent a conscious management decision to extend the life of this organization, it will be dissolved.

This decision became effective on March 1, 1985. The organizational structure of the State Office will not be altered. However, GIS will be implemented with the following informal (ad hoc) structure:

Branch Chief
Information Services

GIS Applications Manager | GIS Operations Manager | GIS Cartographic Manager

*User's Committee

*User's Committee will be comprised
of one member from each DO and
Division in the SO as appropriate.
RO members may also be added as appropriate.

The Operations Manager, Applications Manager and Cartographic Manager will be responsible to their existing supervisors. However, on GIS matters they will be directly supervised by the Branch Chief, Information Services on an ad hoc basis regarding GIS matters.

Specific GIS functions are described below:

GIS FUNCTIONAL RESPONSIBILITIES

I. Division of Resources, Planning and Environmental Coordination Staff

GIS functions in this staff will be the responsibility of the GIS "Applications Manager" who will serve as the "User Representative." Specific job responsibilities are listed below:

- Reviews proposals, project selections, select projects in accordance with Management Team priorities, project planning, design, and management.
- Chairman of user committee.
- Keeps informed of applications research and recommends possible uses for Bureau adoption.
- Initiates and manages contracts for data acquisition and formatting.
- Administers project data base including design, development, and library administration.
- Provides training to user groups on GIS input requirements and products.
- Provides budget estimates for user related actions and AWP development.
- Assists in developing process data handling standards for Utah's GIS program.
- Evaluates technical adequacy of Lands and Renewable Resources inventories for use in the automated systems.
- Coordinates all workload estimates and projects with Branch Chief, Information Services.

II. Division of Operations - Cartographic Section

GIS functions of this staff will be the responsibility of the GIS "Cartographic Manager" who will serve as the "Mapping Standards Coordinator." Specific responsibilities are listed below:

- Assists in developing cartographic input and output standards for the GIS process for all users in the state.

- Maintains Bureau mapping standards in GIS processing and products.

- Provides training to GIS users on mapping standards.

- Develops digital cartographic applications.

- Provides budget estimates for mapping requirements of the automated system for AWP development.

- Assists GIS users in developing resource data portrayal methods that will facilitate data transfer to the GIS.

- Assists cartographic staff in planning and production of mapping projects requiring GIS technology.

- Coordinates implementation of GIS technology to long-range Cartographic Section production procedures.

- Oversees production of all Cartographic Output System (COS) products.

- Coordinates all projects and estimated workloads with Branch Chief, Information Services.

III. Division of Administration, Branch of Information Services

GIS functions in this Branch will be the responsibility of the GIS "Operations Manager" who will serve as the "Scientific Systems Coordinator." Specific responsibilities are listed below:

- Acquires and maintains physical facilities.

- Acquires, maintains, and develops hardware and software, and coordinates GIS communication issues.

- Supervises the management and manipulation of the data base to meet user needs (including editing and modeling).

- Initiates and manages contracts for remote sensing and digital terrain data acquisition.

- Provides budget estimates for systems-related requirements (equipment, programs, space, etc.)

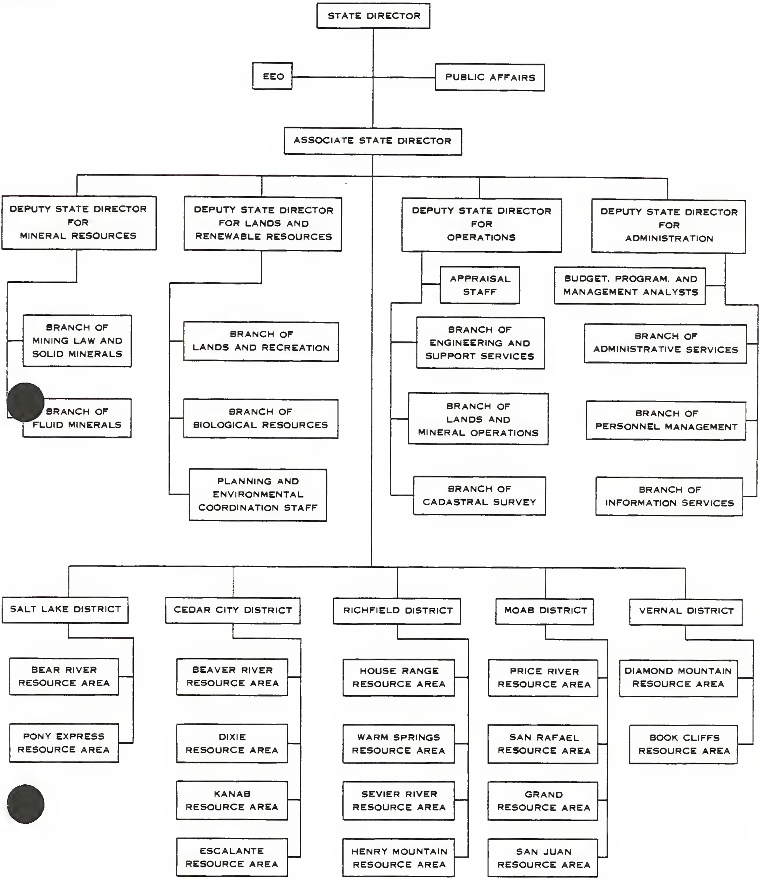
- Keeps informed of technological advances and makes recommendations for Bureau acquisition.

- Provides training for users in technological and operational aspects of the GIS program.

- Assists in developing process standards for Utah's GIS program.

- Schedules the allocation of all system resources.

BUREAU OF LAND MANAGEMENT - UTAH ORGANIZATIONAL CHART



14. STAFF

A. Existing Staff

Existing staff working on GIS essentially include five people, not all of which serve in a full time capacity. Current staff include two Digitizers, a GIS Coordinator/Remote Sensing Specialist, one person from the Planning and Environmental Coordination staff, and one person from the Cartographic Section staff. As reflected in the Functional Responsibilities and Organizational Structure section these people will devote full time to GIS as their first priority responsibility. Also, the respective position descriptions of the latter three will be changed to reflect their respective positions in GIS as outlined in the Functional Responsibilities and Organization Structure Section. While the Information Services Branch Chief will retain the overall responsibility for GIS implementation, including overall policy and strategies, these people will comprise the primary GIS core team responsible for implementation of GIS.

B. Proposed Staff

Additional staffing will be required as GIS implementation begins to reach greater proportions. Listed below are the functional roles that will be required and an estimate of the work effort in work years to support full implementation of GIS in the State Office and support GIS at the District Office level.

TABLE No. 18

Fiscal Year
work effort in work years.

State Office Functional Roles	-1	0*	+1	+2	+3	+4	+5
GIS Operations Management	0.2	.8	1.0	1.0	1.0	1.0	1.0
Digitizing	1.0	2.0	3.0	4.0	4.0	4.0	4.0
Computer Systems Programming	0.2	0.2	0.7	0.7	0.7	0.7	0.7
Computer Operations	0	0	0.5	0.5	0.5	0.5	0.5
Data Base Administration	0.2	0.2	0.5	0.8	0.8	0.8	0.8
Applications Programming	0	0.2	0.8	1.0	1.0	1.0	1.0
Cartographic Management	0	0.5	1.0	1.0	1.0	1.0	1.0
Project Planning	0	0.3	0.3	0.3	0.3	0.3	0.3
GIS Applications Management	0.2	.8	1.0	1.0	1.0	1.0	1.0
Training	0.1	0.1	0.2	0.2	0.2	0.2	0.5
Totals	1.9	5.1	9.0	10.5	10.5	10.5	10.8

* 0 = Year of delivery for level A computer.

Note: The list represents functional roles, not positions. In some cases a single individual can serve in more than one functional role.

State Office Functional Roles

GIS Operations Management - Oversight of physical facilities and digitizing. Technical management of GIS system including both hardware and software issues. Previously defined in Functional Responsibilities and Organization Structure.

Digitizing - Data entry and editing, this includes a work leader who supervises all data entry and coordinates all editing, documentation of themes and insures accuracy of data input.

Computer Systems Programming - Maintenance and improvement of system operations (hardware and software). Maintain and update software. Identifying need for hardware/software upgrades. Monitoring system use.

Computer Operations - Booting and debooting system. Responding to console requests for tapes/disk mounts and dismounts. Operations of on-line printer and performing simple console instructions.

Data Base Administration - Development and administration of GIS data base including documentation and library. Determination of access control parameters.

Applications Programmer - Maintenance and development of GIS software. Identification and resolution of problems with GIS program or operational effectiveness. Performance of file and data manipulation for GIS users.

Cartographic Management - Design and production of finished (official/published) GIS cartographic output. Coordination between GIS staff and Cartographic Section. Previously defined in Functional Responsibilities and Organization structure.

Project Planning - Developing and implementing project assistance program including proposals, design, oversight, and documentation.

GIS Applications Management - Develops and implements applications of GIS for resource issues. Coordinates GIS user issues and projects. Previously defined in Functional Responsibilities and Organization Structure.

Training - Development and coordination and presentation of GIS user training classes (formal and informal).

TABLE No. 19

Fiscal Year
work effort in work years.

District Office
Functional Roles

	-2	-1	0*	+1	+2	+3	+4
GIS Coordination	0.2	0.4	0.6	0.8	0.9	1.0	1.0
Digitizing			0.4	0.8	0.8	0.8	0.8
Computer Operator/Management			0.5	0.6	0.6	0.6	0.6
Total	0.2	0.4	1.5	2.2	2.3	2.4	2.4

* 0 = year of delivery for level C minicomputer.

District Office Functional Roles

GIS Coordination - Coordination of GIS data collection, applications, projects and data base manipulation. District specialist on GIS issues.

Digitizing - Data entry and editing.

Computer Operation/Management - Operation of District level C computer, including maintenance of software and monitoring system use.

15. TRAINING

The training required for a user to be able to operate the system at a basic level involves about one week of study focusing on the MOSS software package. Acquiring a complete understanding of GIS capabilities takes years of day-to-day interaction with the system. Fortunately, it is not necessary for a user to have a complete knowledge of the system in order to effectively use it as a management tool. Training materials and instruction for MOSS have been standardized between WELUT and DSC. Utah will take advantage of this effort and will also provide additional training whenever possible.

The following is a proposed list of training courses recommended for those people who will be involved with GIS:

A. GIS ORIENTATION

Who receives	All GIS users, potential users, interested personnel
Who gives	S.O. and DSC GIS staffs
Where	S.O., District Offices, A.O.'s
Objective	To familiarize users and potential users with system capabilities, limitations, and applications to BLM programs. This training should be offered periodically to accommodate new personnel and changes in the system.

B. Graphic Computer Operating System - introductory level

Who receives	All GIS users
Who gives	S.O. GIS staff
Where	S.O., District Offices
Objective	To enable GIS users to gain a working knowledge of operating systems functions so they can effectively access, manipulate, and store GIS data.

C. Graphic Computer Operating System - advanced level

Who receives	S.O. Systems Programmer, selected individuals
Who gives	Vendor
Where	S.O. or Vendor site
Objective	To enable Information Services staff to gain a thorough knowledge of the operating system capabilities.

D. ADS (Automated Digitizing System)

Who receives	S.O. digitizing staff and selected individuals
Who gives	USO with assistance from DSC
Where	USO or District Offices
Objective	To familiarize all personnel who will be involved in the data capture process with the Automated Digitizing System.

E. MOSS (Map Overlay Statistical System)

Who receives	All GIS users
Who gives	DSC, USO
Where	DSC, USO, District Offices
Objective	Since MOSS is the software structure which provides the data analysis capabilities of the system, every user who wishes to work with GIS data must be familiar with the MOSS software commands. The objective is to train field and State Office personnel so that they are capable of accessing, manipulating, and portraying GIS data in order to meet their resource management needs.

F. COS (Cartographic Output System)

Who receives	S.O. cartographic staff and selected individuals
Who gives	DSC
Where	DSC or USO
Objective	To enable cartographic staff to provide quality graphic products from GIS data when required.

G. DBMS (Data Base Management System)

Who receives	Field user, most GIS users
Who gives	Vendor, SO
Where	USO or District Office
Objective	To enable user to link additional attribute data to the GIS analytical software. Manipulate the DBMS query language to meet resource analysis requirements.

16. STANDARDS

Several types of standards will have to be developed as GIS is implemented in Utah. Some of the standards needing attention include: 1) data standards, 2) mapping standards and 3) project documentation standards. In addition, there is a need to develop project planning guides, user guides and criteria for selecting project priorities for use of the system. Standards must be compatible with overall Bureau requirements, meet user needs and be adaptable to particular system needs.

While it is not practical to address these issues in full detail in this document we are scheduling a standards development phase as part of our implementation plan. The effort will begin immediately after formal approval of the implementation plan and will be completed prior to installation of the State Office minicomputer. Standards development will require input from State Office, District, and Resource Area specialists. The scope of the standards development phase will include the following:

1) Data Standards

   a) Identification of standard data themes
   b) Identification of partially standard data themes
   c) Description of menu names for standard and partially standard data themes
   d) Description of menu content for standard and partially standard data themes
   e) Description of standard codes for attribute categories
   f) Description of standards for naming MOSS master map files
   g) Description of suggested guidelines for naming MOSS work map files

2) Mapping Standards

   a) Determination of minimum cartographic standards for specific themes
   b) Description of line type, symbol type, and color for all standard and some partially standard data themes
   c) Description of procedures for handling data from maps of different scales or degrees of accuracy.
   d) Description of procedures for dealing with maps having different projections, especially small-scale maps.
   e) Definition of standard "Base Map" themes for use as cartographic output rather than analysis

3) Project Documentation Standards

   a) Procedures for tracking the source, date, and accuracy of each map/data theme
   b) Procedures for cyclic maintenance and update of existing map data
   c) Procedures for archiving and retrieval of map data
   d) Problems encountered and recommendations for future applications requiring similar analysis capabilities
   e) Procedures used for project planning standards

17. OPERATIONAL PROCEDURES

This section describes the planned flow of data into and out of the GIS system. It specifically addresses data acquisition, data capture (digitizing), and production of output products. Also discussed are issues related to the maintenance and updating of GIS data.

A. Data Acquisition

Data from several sources may be entered into the GIS. These sources include digitized maps, coordinate/data files, digital GIS data from other agencies/systems, and raster imagery. By far, most GIS data will be from in-house digitized maps. These maps will be both published maps and working maps/overlays.

The standard base for digitizing map products will be the 7-1/2' quad at 1:24,000 scale. As much as possible all data entered into the GIS should be in the 7-1/2' quad format. Obviously this will not be possible in all cases. Some information is only available on smaller scale maps. In a few situations, this information may be entered into the GIS system at 7-1/2' accuracy if it is coincident with features already digitized from 7-1/2' maps. An example of this would be lease tracts which follow legal descriptions. In such cases, we would duplicate the necessary land lines on a new theme.

There will also be situations which do not justify the 1.24,000 scale accuracy. While this data may be digitized directly at the existing map format, it may be desirable to digitize in 7-1/2' quad units for data management consideration. An example of such information would be precipitation or rainfall data.

Also, there may be some regions where it will be desirable to enter all data at a smaller scale than 1:24,000. For areas of low activity, few resource issues, scattered tracts, or with data already compiled at a 1:63,360, 1:100,000, or 1:126,720 scale base, it may be more efficient to digitize the data at the smaller scale. One example of this in Utah is Utah County. Because of the factors mentioned above, it was decided to enter GIS data for this area from 1.100,000 scale base maps.

Finally, there is a requirement to display information on a State base. Therefore, we will maintain basic map information for a limited number of resource themes on a Statewide basis. For this purpose we will use the 1:500,000 State map Current activity is being done using the BLM State map as a base which has a polyconic projection. Once ADS can effectively handle maps of different projections, the USGS-Lambert Conformal Conic base map will also be used.

The "standard" resource information to be entered into the GIS system should be compiled to the specifications described in BLM WO-IM 83-220 dated January 4, 1983 (see Appendix No. 5). These specifications generally require that resource data be compiled on mylar overlays registered to a stable

(plastic base) copy of the 7-1/2'1:24,000 scale base map. The base map can be either a topographic map or orthophotoquad. Overlays should display only a single resource theme and should be clearly labeled with map name, map number, theme name, and date. In addition, it is most important to clearly and accurately draft the four map corner ticks on the overlay. This is essential for accurate registration of the overlay during digitizing.

To facilitate a standard means of identifying 7-1/2' quads, Utah will use the USGS map reference number. This is a seven-digit number based on the latitude and longitude of the 1°x1° cell in which the quad is located. It is recognized by the USGS and most users of USGS maps as a standard means of identification (see Appendix No. 6).

It is also possible to create a MOSS file from existing tabular data which is defined by a geographic coordinate. This data will typically be point data such as archaeological sites or hazardous waste sites. Data referenced by a UTM or latitude-longitude coordinate can be reformated to MOSS specifications with a minimum of difficulty. Any additional information relating to the sites can also be used by the associative attributes function of MOSS. Data entered into MOSS by this technique will not create an ADS file. This is significant because MOSS does not have any editing capability. Therefore, any editing or maintenance of the data will require the creation of a new MOSS file.

There are several types of data currently available from other agencies. These include the relatively standard Digital Elevation Model (DEM) and Digital Line Graphic (DLG) of the USGS as well as resource data from other GIS systems such as the State of Utah's Automated Geographic Reference (AGR) ARC/INFO system. While all existing and potential sources of digital graphic data are too numerous to mention in this document, we should probably mention a few words about those most likely to be used.

The majority of "purchased" data in Utah's GIS will be DEM data. These data are available from the USGS at $100 per quad plus a tape charge. Utah has already acquired the DEM for approximately 500 quads or one-third the State of Utah. This data requires some preprocessing before it can be utilized by MOSS. Also, because DEMs are CELL data they can only be processed within the MAPS subsystem. Because of the great amount of storage required for DEM data, only a limited number of quads will be on-line at any one time.

The other USGS product, "DLGs" will be used only on a limited basis on Utah's GIS. This is largely because the data are available only for limited areas and then only for the public land survey data and political boundaries. The cost ($40+) for what is received is high considering the data will still require processing to be MOSS compatible. As we will probably have most of the essential DLG themes digitized before they are available from USGS, it is unlikely that Utah will make significant use of DLG data.

The most likely source for GIS data is from the State of Utah's GIS (AGR) system. This system uses the ARC/INFO software developed by the Environmental Systems Research Institute (ESRI) in Redlands, California. While this GIS software is quite different from MOSS, there are reported to be programs available to convert ARC/INFO data into a MOSS compatible form. While these programs may turn out to be elusive to track down when the time actually comes for data conversion, it is nonetheless clear that it would be possible to convert data from one system to another. The important thing to keep in mind is that when transferring data from one system to another it will always involve work of some kind. The effort to perform these conversions could be significant. Hopefully, after several exchanges of data between the same systems, procedures and programs will be developed to keep the effort to a minimum.

A GIS has the potential to greatly enhance the utility of remotely sensed data. Most remotely sensed data, and particularly LANDSAT, is usable in a GIS as cell data. This holds the prospect of easy and quick extraction of information from an image through the use of existing digital or ancillary data. Although MOSS is not image processing software, it can effectively utilize a classified Landsat image to derive new information. As with most sources of GIS data, this will require some preprocessing of the data. This preprocessing would be best performed using the DSC's IDIMS system. As more states develop GIS systems, there will be a greater requirement for image processing support from DSC. It is important that the Bureau retain this capability and give it the opportunity to develop.

Data Capture (Digitizing)

Utah's approach to digitizing will incorporate use of both contract and in-house capabilities. The in-house digitizing is being planned as a centralized service at the Utah State Office. Eventually. in the optimum alternative, some digitizing capabilities will be established at the District Offices. However, District digitizing will usually be limited to partially standard themes and maintenance work.

Contract digitizing appears to offer a most attractive alternative to an office just beginning GIS operations. It promises avoiding the hiring, training and supervision of digitizing operators; and the acquisition, operation and maintenance of digitizing equipment. In many cases, it can work quite effectively and produce a quality product in a short time. There are situations, however, where contracting is not the answer and the in-house capability will perform more effectively. To understand the differences between these two situations it is important to look at the nature of the work to be performed.

The data entry software (either ADS or AMS) is unforgiving of mapping errors. It insists that lines be edge matched, polygons close, attributes be properly named, and the map information is concise and complete. If the map material to be digitized was perfect in every respect, contracting would be an effective means of accomplishing it. Unfortunately, perfect map material is the exception rather than the rule. Too often the accuracy and completeness of the mapping is far below what it should be. In spite of resource mapping

standards which have been in effect for nearly 5 years, many map overlays are compiled depicting several resource themes. When such material is contracted to be digitized, much of the funding is consumed by map editing. This is a time-consuming process which requires effective communication between resource specialists and the digitizers. Too frequently the digitizing contractor is in another state making communication difficult. More importantly, the contract digitizer is unlikely to have staff who understand specific resource themes and BLM procedures. For these reasons we estimate that only between 30 to 50 percent of Utah's resource data will be suitable for contract digitizing.

Even when map materials are properly constructed and accurate, contracting requires a measurable overhead of in-house work. The material must be aggregated and inspected prior to shipping to the contractor. Theme menus and other information specific to the work must be communicated to the contractor. During the digitizing process verification plots must be edited for errors. The final data also should receive a thorough review for accuracy and completeness prior to acceptance. In Utah's view, this contract maintenance will be a joint effort of our digitizing staff and field office resource specialists.

The question of how to organize in-house digitizing operations is a major issue confronting each State considering GIS. Digitizing is the first and most important aspect of developing a GIS. The success or failure of a project depends greatly on how the map information is handled during digitizing. Digitizing is also the most labor intensive and costly aspect of a GIS project. Therefore, different approaches to digitizing can greatly affect the cost of GIS.

This plan proposes a centralized digitizing operation at the Utah State Office to service all State projects. Eventually, digitizing capabilities will be developed at District Offices; however, these operations will be limited in their responsibilities and size. We believe this approach is the best means of developing a successful GIS at a reasonable cost.

Field offices' interaction with GIS is most logical during the analysis phase. Our plan tries to emphasize field access to their data for analysis and the production of working products. Of course, field offices will determine what should be digitized and identify the goals of specific projects. However, to carry this to the conclusion that they must also perform digitizing ignores many facts. The following chart identifies the advantages and disadvantages of both a centralized and decentralized digitizing operation. We believe the worst-case scenario would be for all digitizing to be done at field offices by resource specialists. This would be the most costly and least successful approach.

DIGITIZING ALTERNATIVES

Advantages:

Centralized

- Lower Operational Cost
- Less hardware to purchase (3 stations)
- No data communications costs
- Minimize data communications problems/errors
- Facilitates higher data communications rates
- Facilitates focus on State priorities
- Greater system production capability
- Multiple stations facilitates shift work
- Access to college students for shift work
- Experienced operators develop greater expertise and speed
- Greater control of data quality/standards
- Faster processing on large CPU

Decentralized

- Easier to involve resource staff in GIS
- Closeness to resource specialist facilitates correction of errors
- Field office has full control of their own data

Disadvantages:

Centralized

- Removed from field resource staff
- Does not encourage direct involvement of field offices
- Error correction requires communication with field office
- Field offices relinquishes responsibility for their data

Decentralized

- Greater operational cost
- More equipment required (5+ stations)
- More operators required
- Communication equipment required
- Vulnerable to data communication problems/errors
- Field offices must commit to digitizing position
- Individual operators must consult S.O. for technical assistance
- More difficult to focus on state priorities
- Single stations do not facilitate shift work
- Less control of data standards

Our in-house digitizing operations will be established in the Branch of Information Services. This is where the expertise currently resides. During the initial period of GIS development it is essential that the data base construction be closely managed to assure that projects are successful and data is compatible with statewide standards. At this time such management and oversight is best accomplished in the Branch of Information Services. However, this does not preclude a review of these functions and their organizational placement once operational procedures have been developed and our expertise has broadened.

While most digitizing is to be centrally located we are not ignoring the needs of field offices for data entry capability. Our optimum alternative equipment acquisition schedule includes one digitizing station with each District Office level C system. This assumes the District agrees to assume some responsibility for GIS operation. These systems are scheduled for each District shortly after a major project/data base is established. Once the District has had the experience of a GIS project on the central system, they will be in a better position to assume responsibility for management of GIS operations on their level C system. This includes responsibility for the data entry functions as well. We believe it would be most unadvisable to have field offices begin to digitize data before fully experienced in all phases of GIS operations.

One result of our GIS standards effort will be that some themes will be designated as having a higher level of management than others. Data themes requiring close management will be digitized to precisely defined specifications.

Standard theme menus will be developed to facilitate adherence to specifications. Each phase of digitizing progress is to be tracked for each map/theme unit. Additional information describing the source data, its accuracy, origin, and date will be documented for each map/theme unit.

Responsibility for digitizing the more highly managed themes will be retained at the State Office. Obvious examples of such themes are the land grid and land status information. Most District digitizing will usually involve less tightly managed themes and some types of maintenance on other themes. Nearly all production digitizing will occur at the State Office. Procedures for maintenance of themes at field offices will be developed during our standards effort as changes will have to be transferred to the central data base.

B. <u>Data Maintenance</u>

Keeping GIS data current and accurate is expected to become a significant workload as the data base grows. The principle questions involved in data maintenance are: who will do it and how will it be done? Obviously, procedures will have to be developed to insure that key data base themes are kept current.

Because most changes and updates will be identified at the field level (Districts or Areas), it may be attractive to have the Districts responsible for all data maintenance. However, to do so presents some management and technical problems. Those data themes identified as having a higher level of management will be maintained by the State Office.

This is to assure an adherence to a single standard format for statewide compatibility. Themes with a lower level of management will be maintained by the District Office. Which themes will be involved will be determined by our standards development effort.

The changes associated with data maintenance will be performed on the ADS subsystem. This is necessary because of the limited editing capabilities of MOSS. After changes are made in ADS new MOSS master and work files will have to be created. This could result in a significant amount of processing for an otherwise insignificant change. Unfortunately, until MOSS has full editing capabilities it will be necessary to maintain both an ADS and MOSS record of each map. Hopefully when MOSS goes to an arc/node architecture it will have full editing functions with password protection. This would significantly lower data base maintenance costs.

Because of the need to maintain both ADS and MOSS data files, maintenance will have to be closely coordinated between the Districts and State Office. Themes which reside only on the District level C system will not require coordination. However, themes on the State Office system, whether maintained by the District or State Office, will require interoffice coordination. If Districts maintain the theme they will have to request the specific ADS files be put on line. This will be necessary because non-active ADS files will normally be archived. If the maintenance is performed on the District system, the corrected MOSS files will then have to be transferred to the State Office system. Similarly, maintenance performed by the State Office will require transfer of the updated MOSS files to the District system. The actual procedures to manage data base maintenance may require a moderate level of experience before they can be fully developed.

C. Output Products

This section will discuss the manner in which Utah will manage the production of GIS products. It deals with the issues of who will initiate output, technical considerations related to output production, and what controls or standards will be implemented. To do this it is necessary to define GIS output products.

In one sense all GIS output is simply another data file on the computer. These files may be displayed, printed, plotted, archived, or deleted. Output may be produced from any of the three GIS subsystems (ADS, MOSS, COS). Output from ADS will be either a plot file or MOSS master file. ADS can also produce tabular edit displays and theme menus. However, because these are internal to ADS, they are not considered output products. Output from MOSS includes tabular reports, new or composite maps, and plot files. Output from COS is limited to plot files.

Initially, ADS output will be produced only by the State Office digitizing staff. After Districts receive their level C systems, District digitizing should be performed only by trained operators. State Office and field users will not have access to the ADS subsystem. The digitizing staff will maintain ADS data on-line until a project or specific portion of a project is completed. At such time MOSS master map files will be produced and ADS data files (symbol, raw line, closed line, polygon and attribute files) will be archived. Any plot files produced for ADS verification plots will also be deleted at this time.

MOSS output products will be generated by State Office and field users. The only exception to this will be when users request the assistance of GIS staff. The requirements and specifications for MOSS output products will be entirely user defined. There will not be fixed standards for MOSS output. Users will be required to manage the ultimate disposal of their MOSS output products. Users will be allocated a finite amount of on-line data storage. This will require constant monitoring to assure that there is sufficient unused file space to perform the desired analytical processing. Once the available on-line storage is used, users will determine which files are to be deleted and which are to be archived. The users will also initiate the appropriate action. With the exception of MOSS master map files, users will have total discretion in deleting or archiving files. In multi-user directories, procedures must be established to coordinate file management activity among individual users.

Until field users have a plotter in their offices, they will be required to have the State Office produce their plotted output. The State Office will respond to user phone requests for plotting existing plot files. The user must provide the directory/file name of the plot file. Requests for large or multiple plots may have to be deferred for off-peak periods. Once produced, plotted output will be mailed to the user. Eventually, in the optimum and preferred alternatives, all field offices will have color plotting capability thus reducing the need for State Office plotter support. However, very large-sized plots or output best produced on an electro-static plotter will continue to be plotted at the State Office.

Most users will have little or no access to the COS subsystem. While not excluding users from accessing COS, we will not actively encourage it either. COS is intended for finished cartographic output. Nearly all user requirements for vector map output can currently be met with MOSS. MOSS should also soon be able to support cell map output. Only when official finished maps are required do we perceive a need for the COS subsystem. In such cases the State Office Cartographic Section should assist users in map production. Users may have to provide the MOSS map files for input, however, official map content and design should be approved by the State Office Cartographic Section.

18. PROJECT CONTROL

A. Project Planning

Developing Project Planning guides requires input from State Office, District, and Resource Area personnel. Therefore, detailed user guides will be developed when the implementation plan is approved and the minicomputer is installed in the State Office. For the purpose of steering the development of project planning guides and related materials, the following guidance is provided in this document:

A project may be defined as any GIS effort requiring the input/digitizing of new data. To successfully plan, manage, and conduct a project, a number of steps are required. These steps apply after the project goals/objectives have been clearly defined and the study area identified. Whether formal or informal, the 10 basic steps that follow are essential elements that must be addressed by a user in the project design process:

1. Preliminary description of final products desired (i.e., maps, statistics, reports, data bases, etc.) and how they are to be utilized.

2. Analysis of the input data required to develop the intended products.

3. Review and documentation of input data availability, format, scale, content, etc.

4. Development of data/flow processing scheme, including models to be used.

5. Identification of software packages to be utilized and training needs (ADS, MOSS, COS).

6. Development of a project plan, including time estimates and final products.

7. Commitment by the user of funds and manpower to complete the project.

8. General training.

9. Project-specific individual training.

10. Production.

Steps 1, 2, and 3 usually are completed by the user before any serious discussions with S.O. GIS Staff are initiated. Steps 4, 5, and 6 are completed by the user with technical assistance from S.O. GIS Staff. Step 7 is critical. Without an adequate user commitment, GIS resources will not be made available. Steps 8, 9, and 10 represent project implementation.

Using these steps as a foundation, the major topics of the project planning guides will be:

1. Project Planning Overview

2. Flow Chart - showing relationships to various events

3. GIS Project Proposal form/with instructions

4. GIS Project Proposal Evaluation Criteria

5. Project Planning Procedures Guide

6. GIS Project Documentation Guides

Development of these guidelines will follow the basic steps and will be designed to help the user identify opportunities, constraints, and the necessary commitments for successful completion of a project in an efficient manner.

GIS User Committee

Establishment of a GIS User Committee will accomplish several important items, all of which should enhance communications, user assistance between various offices, and system operation.

1. It provides a formal mechanism for user feedback on system operation, enhancements and/or problems encountered while using the system as well as new application techniques.

2. It enhances communication on GIS throughout the various offices by providing a single point of contact in each office.

3. Technology transfer can be more easily accomplished.

4. Contact person will be able to readily solve problems, answer questions, and provide individual training for their respective offices, thus reducing the need for user assistance from the State Office.

The User Committee will be composed of one person from each of the respective offices (DO and SO division) which utilize GIS capabilities. Each person serving on the committee should be elected and formally designated by their particular office as the central contact person for that office.

B. Priorities

In order to make the most efficient use of the GIS system and be responsive to statewide issues, each project requiring input of new data must be selected based on how well it fits into the overall statewide goals and objectives. As a start, the following general criteria will be considered in establishing priorities for use of the GIS system:

- Does the project conform to State Management by Objectives priorities?
- Does the project advance the goals and objectives set by S.D. in implementing GIS?
- How critical is the project to the State as a whole?
- Is the project one that will contribute beneficially to the long term data base?

- What is the priority of the office making the request?
- Is the GIS system the appropriate tool for the project? Can the project be successfully accomplished by the GIS system?
- Is the proposed schedule realistic for the tasks associated with the project?
- Data availability
- Manpower availability
- Funding availability

As experience is gained and more demands are placed on the system, the above criteria may need refinement and/or more detailed criteria developed to prioritize the allocation of personnel and systems resources. In the meantime, if conflicts arise that cannot be successfully negotiated, the management team will determine project priority.

C. Project Documentation

Each project requiring new data must be documented to inform others what was done and to build a library of data that can be used for secondary purposes. To accomplish this, a written summary of the project will be completed laying out the purpose, results, and execution of the project. In addition to the summary, a project documentation record will be completed. This project documentation record will contain specific information about the project such as data themes, source data, location and other such information. See Appendix No 7 and No. 8 for proposed GIS project documentation forms. The specific documentation to be collected will be determined as part of our GIS standards effort.

19. COST/FUNDING

Funding required to fully implement GIS in Utah BLM is directly related to: 1) hardware/software needs; 2)required maintenance and operational support; 3) schedule for implementing GIS (based on RMP planning schedule); and 4) personnel needed for the various functional responsibilities required by the system. The figures reflect the full cost of an optimal GIS and related activities, although some equipment and personnel are already in place and are being or have been funded from other activities. In many respects the costs identified for GIS implementation are not new or additional costs, but instead represent changes in the way we spend our funds. Also, some funding can be deferred if it is determined that less than optimum system will be implemented. See Section 21 (Alternatives) for funding details of the various alternatives considered.

Total Estimated Cost for Optimum Alternative - Summarized in ($000)

State Office	FY85	FY86	FY87	FY88	FY89	FY90
Equipment	348.6	156.0	154.8	129.2	48.2	0.0
Procurement	14.5	42.7	59.8	78.3	95.2	104.2
WM	102.5	255.0	262.5	262.5	262.5	270.0
Sub-Total	465.6	423.7	477.1	470.0	405.9	374.2
District Offices						
Equipment	0.0	52.0	264.0	275.4	275.4	286.9
Procurement	57.0	100.0	47.0	147.6	106.9	159.1
WM	0.0	80.0	125.0	167.5	222.5	270.0
Sub-Total	57.0	232.0	436.0	590.5	604.8	716.0
Total Est. Cost	522.6	655.7	913.1	1,060.5	1,010.7	1,090.2

Fiscal year 85 funding has already been programmed from several benefiting activities. It is anticipated future funding will be allocated from the benefiting activities at the State Office level.

TABLE No. 20

Detail of Optimum Alternative Procurement Costs ($000)

State Office System

	FY85	FY86	FY87	FY88	FY89	FY90
Contracting Digitizing	0.0	0.0	0.0	0.0	0.0	0.0
Data Purchase (SCS/DEM/DLG)	0.0	0.0	0.0	5.0	10.0	10.0
Equipment Maintenance	4.5	31.0	42.0	54.0	64.0	68.0
Software Subscriptions	0.0	1.7	2.8	4.3	6.2	6.2
Supplies	10.0	10.0	15.0	15.0	15.0	20.0
Total	14.5	42.7	59.8	78.3	95.2	104.2

District Office Systems

	FY85	FY86	FY87	FY88	FY89	FY90
Contract Digitizing	37.0	68.0	0.0	71.0	0.0	0.0
Data Purchase (SCS/DEM/DLG)	20.0	30.0	35.0	35.0	35.0	35.0
Equipment Maintenance	0.0	0.0	4.0	24.0	44.0	86.0
Software Subscriptions	0.0	0.0	0.0	3.6	7.9	12.1
Supplies	0.0	2.0	8.0	14.0	20.0	26.0
Total	57.0	100.0	47.0	147.6	106.9	159.1

(1) Funding for contract digitizing will be by users (i.e. field offices)

(2) Contract digitizing is based on having four digitizers in S.O. from FY87.

(3) Equipment maintenance is based on 7.5 percent of purchase price

(4) Software subscription fees are based on 10 percent of initial license

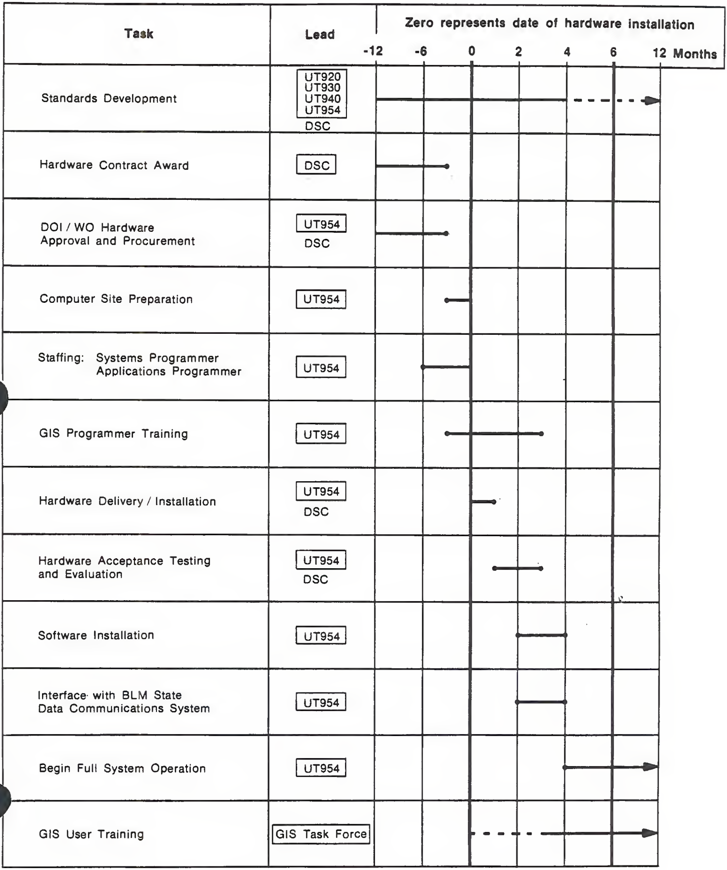
(5) Equipment maintenance and software subscription fees begin in the year following acquisition.

20. SCHEDULES AND MILESTONES

This section identifies the major tasks for implementing GIS in Utah. The tasks are scheduled separately for each office in which a GIS minicomputer will be installed. The schedules identify the approximate start and completion dates for each task, as well as which office has the lead responsibility. It is based on an assumed FY85 award of a contract to acquire GIS hardware. Delays in the award of the contract will affect the schedules accordingly. It is assumed in each alternative, as detailed in Section 21-"Alternatives" that the RMP schedule for GIS implementation will be followed.

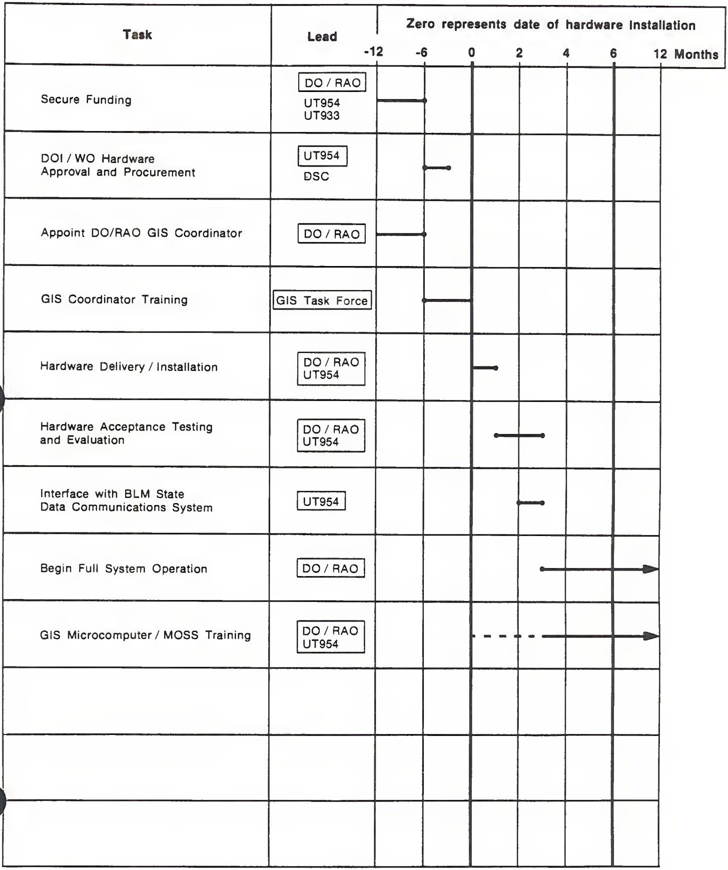
GIS Implementation Schedule

Preferred Alternative - Utah State Office



GIS Implementation Schedule

Preferred Alternative - District and RA Offices



21. ALTERNATIVES

The following pages provide detail of the funding required for four implementation alternatives. The alternatives strive to maintain at least a minimal level of field access to the GIS. In the minimal alternative Resource Area Offices do not have access to GIS. For this reason alone the minimal alternative is not recommended and should be avoided.

The optimum alternative emphasizes both field access and performance. It is intended to give all offices a great deal of autonomity while providing maximum performance in both the central and field systems. The preferred alternative trys to maintain a high level of field access but at some sacrafice to overall system performance.

One thing to emphasize is that these alternatives are only target configurations and can be adjusted to meet changing requirements.

UTAH BLM
GEOGRAPHIC INFORMATION SYSTEM

COST SUMMARY

Optimum GIS Configuration

	0	+1	+2	+3	+4	+5	Total
State Office	465.6	423.7	477.1	470.0	405.9	374.2	2,616.5
District/Areas	57.0	232.0	436.0	590.5	604.8	716.0	2,636.3
Total	522.6	655.7	913.1	1,060.5	1,010.7	1,090.2	5,252.8

Preferred GIS Configuration

State Office	445.6	293.2	445.8	405.0	468.8	434.3	2,492.7
District/Areas	57.0	281.5	277.1	405.0	403.0	464.5	1,881.1
Total	502.6	574.7	722.9	810.0	871.8	898.8	4,380.8

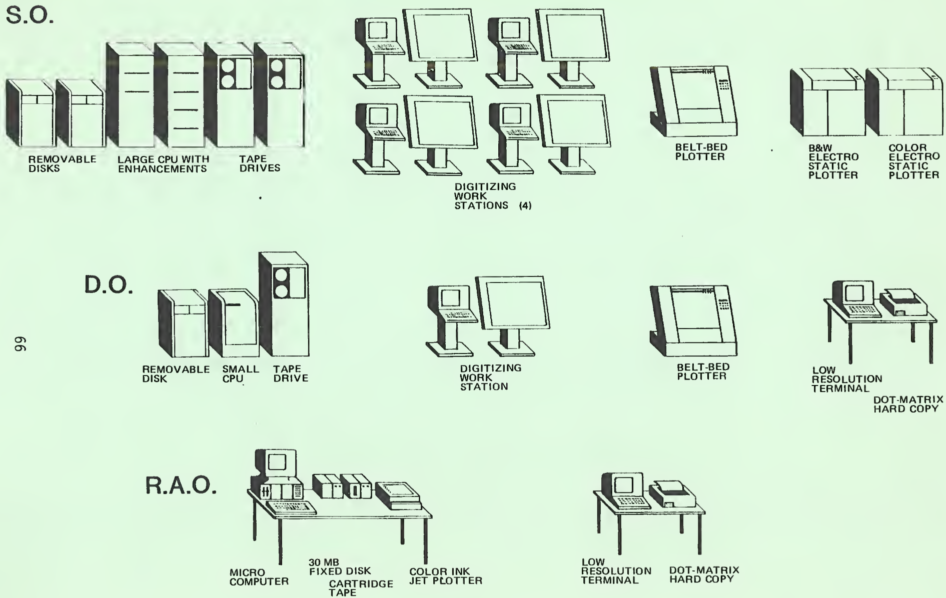
Intermediate GIS Configuration

State Office	405.7	333.2	375.8	419.8	433.6	424.2	2,392.3
District/Areas	45.6	142.9	113.1	198.4	168.6	185.6	854.2
Total	451.3	476.1	488.9	618.2	602.2	609.8	3,246.5

Minimal GIS Configuration

State Office	405.7	268.2	251.8	303.5	329.8	337.9	1,896.9
District/Areas	40.0	107.6	76.5	152.7	127.0	140.0	643.8
Total	445.7	375.8	328.3	456.2	456.8	477.9	2,540.7

OPTIMUM GIS CONFIGURATION



UTAH BLM
GEOGRAPHIC INFORMATION SYSTEM

SUMMARY

OPTIMUM GIS CONFIGURATION

GENERAL DESCRIPTION:

State Office --Large CPU with enhancements to improve performance
--B&W and color electrostatic plotters
--One additional digitizing station
--Data Base management software

Districts --Small CPU for local processing
--One digitizing station
--Drum/belt bed plotter
--Both high and low resolution terminals

Areas --Microcomputer for local processing
--Small color plotter
--Low resolution terminal and hardcopy

COST SUMMARY - summarized in ($000)

STATE OFFICE

	0	+1	+2	+3	+4	+5	Total
Equipment	348.6	156.0	154.8	129.2	48.2	0	836.8
Procurement	14.5	42.7	59.8	78.3	95.2	104.2	394.7
WM Costs	102.5	225.0	262.5	262.5	262.5	270.0	1,385.0
Sub-Total	465.6	423.7	477.1	470.0	405.9	374.2	2,616.5

DISTRICT/AREAS

Equipment	0	52.0	264.0	275.4	275.4	286.9	1,153.7
Procurement	57.0	100.0	47.0	147.6	106.9	159.1	617.6
WM Costs	0	80.0	125.0	167.5	222.5	270.0	865.0
Sub-Total	57.0	232.0	436.0	590.5	604.8	716.0	2,636.3
Total	522.6	655.7	913.1	1,060.5	1,010.7	1,090.2	5,252.8

UTAH BLM
GEOGRAPHIC INFORMATION SYSTEM

DETAIL-PROCUREMENT COSTS ($000)

*** OPTIMUM GIS CONFIGURATION***

STATE OFFICE SYSTEM

	0	+1	+2	+3	+4	+5
Contract Digitizing	0.0	0.0	0.0	0.0	0.0	0.0
Data Purchase (SCS, DEM, DLG)	0.0	0.0	0.0	5.0	10.0	10.0
Equipment Maintenance	4.5	31.0	42.0	54.0	64.0	68.0
Software Subscriptions	0.0	1.7	2.8	4.3	6.2	6.2
Supplies	10.0	10.0	15.0	15.0	15.0	20.0
Sub-Total	14.5	42.7	59.8	78.3	95.2	104.2
DISTRICT OFFICE SYSTEMS						
Contract Digitizing	37.0	68.0	0.0	71.0	0.0	0.0
Data Purchase (SCS,DEM, DLG)	20.0	30.0	35.0	35.0	35.0	35.0
Equipment Maintenance	0.0	0.0	4.0	24.0	44.0	86.0
Software Subscriptions	0.0	0.0	0.0	3.6	7.9	12.1
Supplies	0.0	2.0	8.0	14.0	20.0	26.0
Sub-Total	57.0	100.0	47.0	147.6	106.9	159.1
Total	71.5	142.7	106.8	225.9	202.1	263.3

(1) Funding for contract digitizing will be by users (i.e. field offices)

(2) Contract digitizing is based on having four digitizers in S.O. from FY87.

(3) Equipment maintenance is based on 7.5 percent of purchase price

(4) Software subscription fees are based on 10 percent of initial license

(5) Equipment maintenance and software subscription fees begin in the year following acquisitiion.

UTAH BLM
GEOGRAPHIC INFORMATION SYSTEM

DETAIL WORKMONTH COSTS ($000)

OPTIMUM GIS CONFIGURATION

WM's - STATE OFFICE	0 85	+1 86	+2 87	+3 88	+4 89	+5 90
GIS Operations Mgmt.	0.5	1.0	1.0	1.0	1.0	1.0
Digitizing	2.0	3.0	4.0	4.0	4.0	4.0
Computer Systems Mgmt.	0.1	0.7	0.7	0.7	0.7	0.7
Computer Operations	0.1	0.5	0.5	0.5	0.5	0.5
Data Base Administration	-	0.5	0.8	0.8	0.8	0.8
Applications Programing	-	0.8	1.0	1.0	1.0	1.0
Carto Management	0.5	1.0	1.0	1.0	1.0	1.0
Project Planning	-	0.3	0.3	0.3	0.3	0.3
Applications Management	0.8	1.0	1.0	1.0	1.0	1.0
Training	0.1	0.2	0.2	0.2	0.2	0.5
	4.1	9.0	10.5	10.5	10.5	10.8

WM's DISTRICT OFFICE (TYPICAL SPREAD)

	-2	-1	0	+1	+2	+3
GIS Coordination	0.2	0.4	0.6	0.8	0.9	1.0
Digitizing	-	-	0.4	0.8	0.8	0.8
Computer Oper/Mgmt.	-	-	0.5	0.6	0.6	0.6
	0.2	0.4	1.5	2.2	2.3	2.4

STATE OFFICE SUMMARY

0 (85)	4.1 X 10 = 41 x $2,500.00 =	$102,500.00
+1 (86)	9.0	225,000.00
+2 (87)	10.5	262,500.00
+3 (88)	10.5	262,500.00
+4 (89)	10.5	262,500.00
+5 (90)	10.8	270,000.00
		1,385,000.00

DISTRICT OFFICE SUMMARY

0 (85)	0 =	0
+1 (86)	3.2 X 10 = 32 X $2,500.00 =	$80,000.00
+2 (87)	5.0	125,000.00
+3 (88)	6.7	167,500.00
+4 (89)	8.9	222,500.00
+5 (90)	10.8	270,000.00
		865,000.00

2,250,000

OPTIMAL

USO GIS SYSTEM

2/40
2=quantity
40=total cost ($000)

HARDWARE QUANTITIES

Description	0	+1	+2 (FISCAL YEAR)	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Central Processing Unit									
Level A CPU (w/4MB)	1/158	-	-	-	-	-	1	$158	$158
Level D CPU (W/1MB)	-	1/7	-	-	-	-	1	$ 7	$ 7
Main Memory Increments									
Level A (2MB)	-	2/10	-	2/10	-	-	4	$ 5	$ 20
Disk Storage									
Fixed (350MB)	-	1/25	1/25	-	1/25	-	3	$ 25	$ 75
Add-on (350MB)	-	1/20	1/20	-	1/20	-	3	$ 20	$ 60
Removable (270MB)	1/25	-	-	-	-	-	1	$ 25	$ 25
Add-on (270MB)	1/20	-	-	-	-	-	1	$ 20	$ 20
Fixed (30MB)	-	1/5	-	-	-	-	1	$ 5	$ 5
Tape Storage									
Reel (1600/6250 bpi)	2/80	-	-	-	-	-	2	$ 40	$ 80
Communications									
Modem/async Com. Proc.	1/4	-	-	-	-	-	1	$ 4	$ 4
Modem/async Ports	4/.4	-	4/.4	-	-	-	8	$ 0.1	$ .8
Local/async Com. Proc.	1/4.5	-	-	-	-	-	1	$ 4.5	$ 4.5
Local/async Ports	4/.25	-	-	-	-	-	4	$ .06	$ .25
Synchronous Com. Proc.	-	-	1/4	-	-	-	1	$ 4	$ 4
Synchronous Ports	-	-	4/.4	2/.2	2/.2	-	8	$ .1	$ .8
Hard Copy Devices									
Printer (600 lpm)	1/16	-	-	-	-	-	1	$ 16	$ 16
Printer/terminal	1/3	-	-	-	-	-	1	$ 3	$ 3
Video Display Terminals									
Alphanumeric VDT	2/3	-	-	-	2/3	-	4	$ 1.5	$ 6

OPTIMAL

USO GIS SYSTEM

SOFTWARE QUANTITIES

Description	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Central Processing Unit									
OS - Vendor Specific	1/10	-	-	-	-	-	1	$ 10	$10
FORTRAN 77	-	1/5	-	-	-	-	1	$ 5	$ 5
X.25 network manager	-	-	1/10	-	-	-	1	$ 10	$10
Data Base Mgmt. System	-	-	-	1/19	-	-	1	$ 19	$19
Sort/Merge	1/.5	-	-	-	-	-	1	$ .5	$ .5
Graphics Kernal System	-	-	1/5	-	-	-	1	$ 5	$ 5
Source Code Debugger	-	1/1	-	-	-	-	1	$ 1	$ 1
Text Control Package	-	1/5	-	-	-	-	1	$ 5	$ 5
Performance Monitor	1/6	-	-	-	-	-	1	$ 6	$ 6

OPTIMAL

USO GIS SYSTEM

PERIPHERAL QUANTITIES

Description*	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Special Purpose Processors									
Array Processor (Level C)	-	-	1/20	-	-	-	1	$20	$ 20
Vector-to-Raster Converter w/disk	-	1/40	-	-	-	-	1	$40	$ 40
Digitizing Tables									
Backlight (40"x60")	-	1/10	-	-	-	-	1	$10	$ 10
Hard Copy Devices									
Color Ink Jet Plotter (8-1/2"x11")	-	1/7	-	-	-	-	1	$ 7	$ 7
Drum Pen Plotter (4-8 pen)	1/18	-	-	-	-	-	1	$18	$ 18
B/W Electro Static Plotter w/Random Elements Processor	-	-	1/70	-	-	-	1	$70	$ 70
Color Electro Static Plotter	-	-	-	1/100	-	-	1	$100	$100
Graphics Terminals									
High (Tek 4016)	-	1/18	-	-	-	-	1	$18	$ 18
Monochrome Vector	-	2/3	-	-	-	-	2	$ 1.5	$ 3

* The descriptions do not necessarily represent the equipment that would be procured. They merely describe a typical system currently available.

OPTIMAL

Utah-Districts GIS SYSTEM

HARDWARE QUANTITIES

Description	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Central Processing Unit*									
			Moab	Cedar	Vernal	Richfield			
Level C CPU (W/2MB)	-	-	1/20	1/20	1/20	1/20	4	$ 20	$ 80
Level D CPU (w/1MB)	-	2/14	2/14	2/14	2/14	2/14	10	$ 7	$ 70
		San Raf. Dixie	Escal.	S.L. Kanab	Price				
Main Memory Increments									
Level C (1MB)	-	-	-	1/5	1/5	2/10	4	$ 5	$ 20
Disk Storage									
Fixed (350MB)	-	-	1/25	1/25	1/25	1/25	4	$ 25	$100
Removable (270MB)	-	-	1/25	1/25	1/25	1/25	4	$ 25	$100
Fixed (30MB)	-	2/10	2/10	2/10	2/10	2/10	10	$ 5	$ 50
Tape Storage									
Reel (800/1600 bpi)	-	-	1/30	1/30	1/30	1/30	4	$ 30	$120
Cartridge (6250 bpi/15MB)	-	2/11	2/11	2/11	2/11	2/11	10	$ 5.5	$ 55
Communications									
Local/async Com. Proc.	-	-	1/4.5	1/4.5	1/4.5	1/4.5	4	$ 4.5	$ 18
Local/async Ports	-	-	4/.25	4/.25	4/.25	4/.25	16	$ .06	$ 1
Synchronous Com. Proc.	-	-	1/4	1/4	1/4	1/4	4	$ 4	$ 16
Synchronous Ports	-	-	2/.2	2/.2	2/.2	2/.2	8	$ .1	$ .8
Hard Copy Devices									
Printer (300 lpm)	-	-	1/12	1/12	1/12	1/12	4	$ 12	$ 48
Printer/terminal	-	-	1/3	1/3	1/3	1/3	4	$ 3	$ 12
Video Display Terminals									
Alphanumeric VDT	-	-	2/3	2/3	2/3	2/3	8	$ 1.5	$ 12

* Offices to receive GIS equipment are based on the current planning schedule. This table assumes a hypothetical FY85 date for acquisition of GIS hardware. The schedule could change depending on District requirements or availability of funds.

OPTIMAL

Utah-Districts GIS System

SOFTWARE QUANTITIES

Description	0	+1	+2	FISCAL YEAR +3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
OS - vendor specific	-	-	1/10	1/10	1/10	1/10	4	$ 10	$ 40
Fortran 77	-	-	-	1/5	1/5	2/10	4	$ 5	$ 20
X.25 network manager	-	-	1/10	1/10	1/10	1/10	4	$ 10	$ 40
Sort/Merge	-	-	-	1/.5	1/.5	2/1	4	$ .5	$ 2
Graphics Kernal System	-	-	1/5	1/5	1/5	1/5	4	$ 5	$ 20
Source Code Debugger	-	-	-	1/1	1/1	2/2	4	$ 1	$ 4
Text Control Package	-	-	1/5	1/5	1/5	1/5	4	$ 5	$ 20
Performance Monitor	-	-	1/6	1/6	1/6	1/6	4	$ 6	$ 24

OPTIMAL

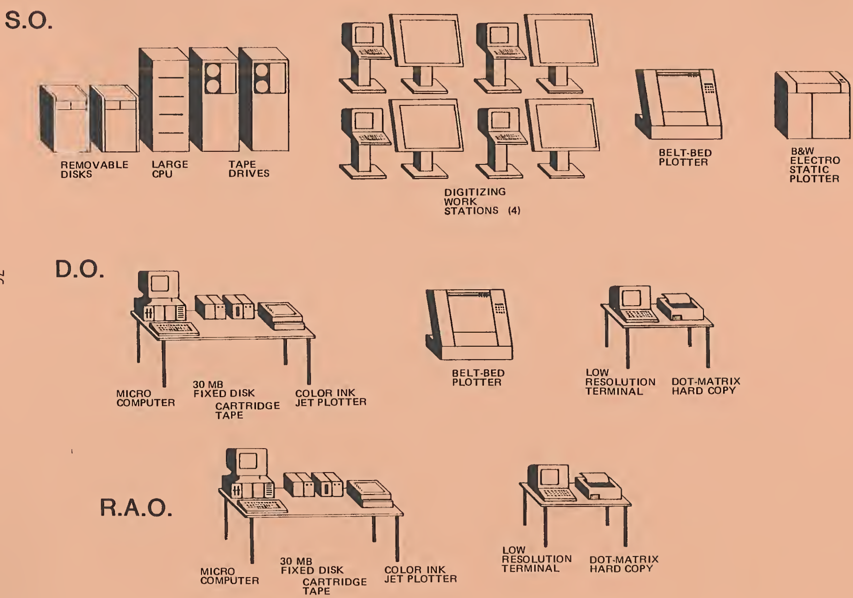
Utah-Districts GIS System

PERIPHERAL QUANTITIES

Description*	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Digitizing Tables									
Backlight (40"x60")	-	-	1/10	1/10	1/10	1/10	4	$ 10	$ 40
Hard Copy Devices									
Color Ink Jet Plotter (8-1/2"x11")	-	2/14	2/14	2/14	2/14	2/14	10	$ 7	$ 70
Drum Pen Plotter (4 pen)	-	-	1/18	1/18	1/18	1/18	4	$ 18	$ 72
Graphics Terminals									
High Res. Storage (TEK 4016)	-	-	1/18	1/18	1/18	1/18	4	$ 18	$ 72
Monochrome Vector	-	2/3	4/6	4/6	4/6	4/6	18	$ 1.5	$ 27

* The descriptions do not necessarily represent the equipment that would be procured. They merely describe a typical system currently available.

PREFERRED GIS CONFIGURATION



UTAH BLM
GEOGRAPHIC INFORMATION SYSTEM

SUMMARY

PREFERRED GIS CONFIGURATION

GENERAL DESCRIPTION:

State Office --Large CPU without enhancements to improve performance
--One additional digitizing station
--B&W electrostatic plotter

Districts --Microcomputer for local processing
--Small color plotter
--Drum/belt bed plotter
--Low resolution terminal and hardcopy

Areas --Microcomputer for local processing
--Small color plotter
--Low resolution terminal and hardcopy

COST SUMMARY - summarized in ($000)

STATE OFFICE

	0	+1	+2	+3	+4	+5	Total
Equipment	330.6	88.0	136.3	10.2	48.2	0	613.3
Procurement	12.5	30.2	42.0	62.3	68.1	71.8	286.9
WM Costs	102.5	175.0	267.5	332.5	352.5	362.5	1,592.5
Sub-Total	445.6	293.2	445.8	405.0	468.8	434.3	2,492.7

DISTRICT/AREAS

Equipment	0	101.5	101.5	101.5	101.5	101.5	507.5
Procurement	57.0	100.0	50.6	136.0	79.0	93.0	515.6
WM Costs	0	80.0	125.0	167.5	222.5	270.0	865.0
Sub-Total	57.0	281.5	277.1	405.0	403.0	464.5	1,888.1
Total	502.6	574.7	722.9	810.0	871.8	898.8	4,380.8

UTAH BLM
GEOGRAPHIC INFORMATION SYSTEM

DETAIL-PROCUREMENT COSTS ($000)

PREFERRED GIS CONFIGURATION

STATE OFFICE SYSTEM

	0	+1	+2	+3	+4	+5
Contract Digitizing	0.0	0.0	0.0	0.0	0.0	0.0
Data Purchase (SCS, DEM DLG)	0.0	0.0	0.0	5.0	8.0	8.0
Equipment Maintenance	4.5	20.5	29.2	44.0	46.6	48.3
Software Subscriptions	0.0	1.7	2.8	3.3	3.5	3.5
Supplies	8.0	8.0	10.0	10.0	10.0	12.0
Sub-Total	12.5	30.2	42.0	62.3	68.1	71.8

DISTRICT OFFICE SYSTEMS

	0	+1	+2	+3	+4	+5
Contract Digitizing	37.0	68.0	0.0	71.0	0.0	0.0
Data Purchase (SCS,DEM, DLG)	20.0	30.0	35.0	35.0	35.0	35.0
Equipment Maintenance	0.0	0.0	7.6	16.0	24.0	32.0
Software Subscriptions	0.0	0.0	0.0	0.0	0.0	0.0
Supplies	0.0	2.0	8.0	14.0	20.0	26.0
Sub-Total	57.0	100.0	50.6	136.0	79.0	93.0
Total	69.5	130.2	92.6	198.3	147.1	164.8

(1) Funding for contract digitizing will be by users (i.e. field offices)

(2) Contract digitizing is based on having four digitizers in S.O. from FY87.

(3) Equipment maintenance is based on 7.5 percent of purchase price

(4) Software subscription fees are based on 10 percent of initial license

(5) Equipment maintenance and software subscription fees begin in the year following acquisitiion.

UTAH BLM
GEOGRAPHIC INFORMATION SYSTEM

DETAIL-WORKMONTH COSTS ($000)

PERFERRED GIS CONFIGURATION

WM's - STATE OFFICE	0 85	+1 86	+2 87	+3 88	+4 89	+5 90
GIS Operations Mgmt.	0.5	1.0	1.0	1.0	1.0	1.0
Digitizing	2.0	2.4	4.6	6.8	7.6	8.0
Computer Systems Mgmt.	0.1	0.4	0.6	0.7	0.7	0.7
Computer Operations	0.1	0.2	0.4	0.5	0.5	0.5
Data Base Administration	-	0.2	0.8	0.8	0.8	0.8
Applications Programing	-	0.4	0.8	1.0	1.0	1.0
Carto Management	0.5	1.0	1.0	1.0	1.0	1.0
Project Planning	-	0.2	0.3	0.3	0.3	0.3
Applications Management	0.8	1.0	1.0	1.0	1.0	1.0
Training	0.1	0.2	0.2	0.2	0.2	0.2
	4.1	7.0	10.7	13.3	14.1	14.5

WM's DISTRICT OFFICE (TYPICAL SPREAD)

	-2	-1	0	+1	+2	+3
GIS Coordination	0.2	0.4	0.6	0.8	0.9	1.0
Digitizing	-	-	0.4	0.8	0.8	0.8
Computer Oper/Mgmt.	-	-	0.5	0.6	0.6	0.6
	0.2	0.4	1.5	2.2	2.3	2.4

STATE OFFICE SUMMARY

0 (85)	4.1 X 10 = 41 x $2,500.00 =	$102,500.00
+1 (86)	7.0	175,000.00
+2 (87)	10.7	267,500.00
+3 (88)	13.3	332,500.00
+4 (89)	14.1	352,500.00
+5 (90)	14.5	362,500.00
		1,592,500.00

DISTRICT OFFICE SUMMARY

0 (85)	0 =	0
+1 (86)	3.2 X 10 = 32 X $2,500.00 =	$80,000.00
+2 (87)	5.0	125,000.00
+3 (88)	6.7	167,500.00
+4 (89)	8.9	222,500.00
+5 (90)	10.8	270,000.00
		865,000.00

2,457,500

PREFERRED GIS CONFIGURATION

USO GIS SYSTEM

2/40
2=quantity
40=total cost ($000)

HARDWARE QUANTITIES

Description	0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Central Processing Unit									
Level A CPU (w/4MB)	1/158	-	-	-	-	-	1	$158	$158
Level D CPU (W/1MB)	-	1/7	-	-	-	-	1	$ 7	$ 7
Main Memory Increments									
Level A (2MB)	-	2/10	-	2/10	-	-	4	$ 5	$ 20
Disk Storage									
Fixed (350MB)	-	1/25	1/25	-	1/25	-	3	$ 25	$ 75
Add-on (350MB)	-	1/20	1/20	-	1/20	-	3	$ 20	$ 60
Removable (270MB)	1/25	-	-	-	-	-	1	$ 25	$ 25
Add-on (270MB)	1/20	-	-	-	-	-	1	$ 20	$ 20
Fixed (30MB)	-	1/5	-	-	-	-	1	$ 5	$ 5
Tape Storage									
Reel (1600/6250 bpi)	2/80	-	-	-	-	-	2	$ 40	$ 80
Communications									
Modem/async Com. Proc.	1/4	-	-	-	-	-	1	$ 4	$ 4
Modem/async Ports	4/.4	-	4/.4	-	-	-	8	$ 0.1	$ .8
Local/async Com. Proc.	1/4.5	-	-	-	-	-	1	$ 4.5	$ 4.5
Local/async Ports	4/.25	-	-	-	-	-	4	$ .06	$ .25
Synchronous Com. Proc.	-	-	1/4	-	-	-	1	$ 4	$ 4
Synchronous Ports	-	-	4/.4	2/.2	2/.2	-	8	$ .1	$ .8
Hard Copy Devices									
Printer (600 lpm)	1/16	-	-	-	-	-	1	$ 16	$ 16
Printer/terminal	1/3	-	-	-	-	-	1	$ 3	$ 3
Video Display Terminals									
Alphanumeric VDT	2/3	-	-	-	2/3	-	4	$ 1.5	$ 6

PREFERRED GIS CONFIGURATION

USO GIS SYSTEM

SOFTWARE QUANTITIES

Description	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Central Processing Unit									
OS - Vendor Specific	1/10	-	-	-	-	-	1	$ 10	$10
FORTRAN 77	-	1/5	-	-	-	-	1	$ 7	$ 5
Sort/Merge	1/.5	-	-	-	-	-	1	$ .5	$ .5
Graphics Kernal System	-	-	1/5	-	-	-	1	$ 5	$ 5
Source Code Debugger	-	1/1	-	-	-	-	1	$ 1	$ 1
Text Control Package	-	1/5	-	-	-	-	1	$ 5	$ 5
Performance Monitor	1/6	-	-	-	-	-	1	$ 6	$ 6

PREFERRED GIS CONFIGURATION

USO GIS SYSTEM

PERIPHERAL QUANTITIES

Description*	0	+1	FISCAL YEAR +2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Digitizing Tables									
Backlight (40"x60")	-	-	1/10	-	-	-	1	$10	$ 10
Hard Copy Devices									
Color Ink Jet Plotter (8-1/2"x11")	-	1/7	-	-	-	-	1	$ 7	$ 7
B/W Electro Static Plotter	-	-	1/70	-	-	-	1	$70	$ 70
Graphics Terminals									
Monochrome Vector	-	2/3	1/1.5	-	-	-	3	$ 1.5	$ 4.5

* The descriptions do not necessarily represent the equipment that would be procured. They merely describe a typical system currently available.

PREFERRED GIS CONFIGURATION

Utah-Districts/Area GIS SYSTEM

HARDWARE QUANTITIES

Description	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Central Processing Unit*									
Level D CPU (w/1MB)	-	3/21	3/21	3/21	3/21	3/21	15	$ 7	$105
Disk Storage									
Fixed (30MB)	-	3/15	3/15	3/15	3/15	3/15	15	$ 5	$ 75
Tape Storage									
Cartridge (6250 bpi/15MB)	-	3/16.5	3/16.5	3/16.5	3/16.5	3/16.5	15	$ 5.5	$ 82.5

* Offices to receive GIS equipment are based on the current planning schedule. The schedule could change depending on District requirements or availability of funds.

PREFERRED GIS CONFIGURATION

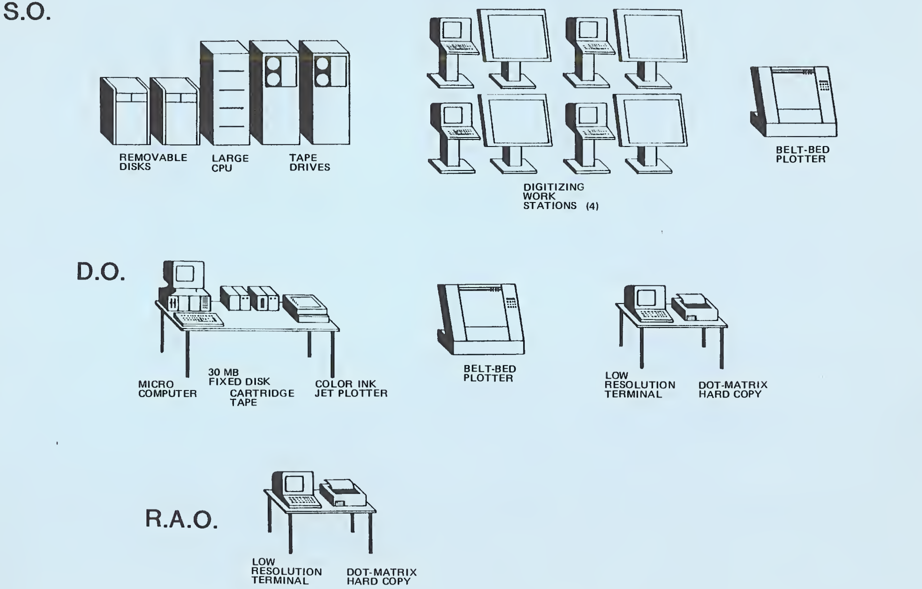
Utah-Districts/Area GIS System

PERIPHERAL QUANTITIES

Description*	0	+1	+2	FISCAL YEAR +3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Hard Copy Devices									
Color Ink Jet Plotter (8-1/2"x11")	-	3/21	3/21	3/21	3/21	3/21	15	$ 7	$105
Drum Pen Plotter (4 pen)	-	1/18	1/18	1/18	1/18	1/18	5	$ 18	$ 90
Dot Matrix Printer	-	4/4	4/4	4/4	4/4	4/4	20	$ 1	$ 20
Graphics Terminals									
Monochrome Vector	-	4/6	4/6	4/6	4/6	4/6	20	$ 1.5	$ 30

* The descriptions do not necessarily represent the equipment that would be procured. They merely describe a typical system currently available.

INTERMEDIATE GIS CONFIGURATION



UTAH BLM
GEOGRAPHIC INFORMATION SYSTEM

SUMMARY

INTERMEDIATE GIS CONFIGURATION

GENERAL DESCRIPTION:

State Office --Large CPU without enhancements to improve performance
--One additional digitizing station

Districts --Microcomputer for local processing
--Small color plotter
--Drum/belt bed plotter
--Low resolution terminal and hardcopy

Areas --Low resolution terminal and hardcopy

COST SUMMARY - summarized in ($000)

STATE OFFICE

	0	+1	+2	+3	+4	+5	Total
Equipment	290.7	128.0	66.3	35.2	23.2	0	543.4
Procurement	12.5	30.2	42.0	52.1	57.9	61.7	256.4
WM Costs	102.5	175.0	267.5	332.5	352.5	362.5	1,592.5
Sub-Total	405.7	333.2	375.8	419.8	433.6	424.2	2,392.3

DISTRICT/AREAS

Equipment	0	47.5	52.5	52.5	52.5	52.5	257.5
Procurement	45.6	80.4	35.6	98.4	48.6	55.6	364.2
WM Costs	0	15.0	25.0	47.5	67.5	77.5	232.5
Sub-Total	45.6	142.9	113.1	198.4	168.6	185.6	854.2
Total	451.3	476.1	488.9	618.2	602.2	609.8	3,246.5

UTAH BLM
GEOGRAPHIC INFORMATION SYSTEM

DETAIL-PROCUREMENT COSTS ($000)

***INTERMEDIATE GIS CONFIGURATION ***

STATE OFFICE SYSTEM

	0	+1	+2	+3	+4	+5
Contract Digitizing	0.0	0.0	0.0	0.0	0.0	0.0
Data Purchase (SCS, DEM DLG)	0.0	0.0	0.0	5.0	8.0	8.0
Equipment Maintenance	4.5	20.5	29.2	33.8	36.4	38.2
Software Subscriptions	0.0	1.7	2.8	3.3	3.5	3.5
Supplies	8.0	8.0	10.0	10.0	10.0	12.0
Sub-Total	12.5	30.2	42.0	52.1	57.9	61.7
DISTRICT OFFICE SYSTEMS						
Contract Digitizing	29.6	54.4	0.0	56.8	0.0	0.0
Data Purchase (SCS,DEM, DLG)	16.0	24.0	28.0	28.0	28.0	28.0
Equipment Maintenance	0.0	0.0	3.6	7.6	11.6	15.6
Software Subscriptions	0.0	0.0	0.0	0.0	0.0	0.0
Supplies	0.0	2.0	4.0	6.0	9.0	12.0
Sub-Total	45.6	80.4	35.6	98.4	48.6	55.6
Total	58.1	110.6	77.6	150.5	106.5	117.3

(1) Funding for contract digitizing will be by users (i.e. field offices)

(2) Contract digitizing is based on having 2 X 8 hr shifts working in S.O.

(3) Equipment maintenance is based on 7.5 percent of purchase price

(4) Software subscription fees are based on 10 percent of initial license

(5) Equipment maintenance and software subscription fees begin in the year following acquisitiion.

UTAH BLM
GEOGRAPHIC INFORMATION SYSTEM

DETAIL WORKMONTH COSTS ($000)

INTERMEDIATE GIS CONFIGURATION

WM's - STATE OFFICE	0 85	+1 86	+2 87	+3 88	+4 89	+5 90
GIS Operations Mgmt.	0.5	1.0	1.0	1.0	1.0	1.0
Digitizing	2.0	2.4	4.6	6.8	7.6	8.0
Computer Systems Mgmt.	0.1	0.4	0.6	0.7	0.7	0.7
Computer Operations	0.1	0.2	0.4	0.5	0.5	0.5
Data Base Administration	-	0.2	0.8	0.8	0.8	0.8
Applications Programing	-	0.4	0.8	1.0	1.0	1.0
Carto Management	0.5	1.0	1.0	1.0	1.0	1.0
Project Planning	-	0.2	0.3	0.3	0.3	0.3
Applications Management	0.8	1.0	1.0	1.0	1.0	1.0
Training	0.1	0.2	0.2	0.2	0.2	0.2
	4.1	7.0	10.7	13.3	14.1	14.5

WM's DISTRICT OFFICE (TYPICAL SPREAD)

	-2	-1	0	+1	+2	+3
GIS Coordination	0.2	0.4	0.5	0.4	0.3	0.3
Digitizing	-	-	-	-	-	-
Computer Oper/Mgmt.	-	-	0.2	0.3	0.3	0.3
	0.2	0.4	0.7	0.7	0.6	0.6

STATE OFFICE SUMMARY

0 (85)	4.1	X 10 = 41 x $2,500.00 =	$102,500.00
+1 (86)	7.0		175,000.00
+2 (87)	10.7		267,500.00
+3 (88)	13.3		332,500.00
+4 (89)	14.1		352,500.00
+5 (90)	14.5		362,500.00
			1,592,500.00

DISTRICT OFFICE SUMMARY

0 (85)	0		= 0
+1 (86)	0.6	X 10 = 6 X $2,500.00	=$15,000.00
+2 (87)	1.0		25,000.00
+3 (88)	1.9		47,500.00
+4 (89)	2.7		67,500.00
+5 (90)	3.1		77,500.00
			232,500.00

1,825,000

INTERMEDIATE

USO GIS SYSTEM

2/40
2=quantity
40=total cost ($000)

HARDWARE QUANTITIES

Description	0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Central Processing Unit									
Level A CPU (w/4MB)	1/158	-	-	-	-	-	1	$158	$158
Level D CPU (W/1MB)	-	1/7	-	-	-	-	1	$ 7	$ 7
Main Memory Increments									
Level A (2MB)	-	2/10	-	2/10	-	-	4	$ 5	$ 20
Disk Storage									
Fixed (350MB)	-	1/25	1/25	1/25	-	-	3	$ 25	$ 75
Add-on (350MB)	-	1/20	1/20	-	1/20	-	3	$ 20	$ 60
Removable (270MB)	1/25	-	-	-	-	-	1	$ 25	$ 25
Add-on (270MB)	1/20	-	-	-	-	-	1	$ 20	$ 20
Fixed (30MB)	-	1/5	-	-	-	-	1	$ 5	$ 5
Tape Storage									
Reel (1600/6250 bpi)	1/40	1/40	-	-	-	-	2	$ 40	$ 80
Communications									
Modem/async Com. Proc.	1/4	-	-	-	-	-	1	$ 4	$ 4
Modem/async Ports	4/.4	-	4/.4	-	-	-	8	$ 0.1	$ .8
Local/async Com. Proc.	1/4.5	-	-	-	-	-	1	$ 4.5	$ 4.5
Local/async Ports	4/.25	-	-	-	-	-	4	$ .06	$ .25
Synchronous Com. Proc.	-	-	1/4	-	-	-	1	$ 4	$ 4
Synchronous Ports	-	-	4/.4	2/.2	2/.2	-	8	$ .1	$ .8
Hard Copy Devices									
Printer (600 lpm)	1/16	-	-	-	-	-	1	$ 16	$ 16
Printer/terminal	1/3	-	-	-	-	-	1	$ 3	$ 3
Video Display Terminals									
Alphanumeric VDT	2/3	-	-	-	2/3	-	4	$ 1.5	$ 6

INTERMEDIATE

USO GIS SYSTEM

SOFTWARE QUANTITIES

Description	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Central Processing Unit									
OS - Vendor Specific	1/10	-	-	-	-	-	1	$ 10	$10
FORTRAN 77	-	1/5	-	-	-	-	1	$ 5	$ 5
Sort/Merge	1/.5	-	-	-	-	-	1	$ .5	$ .5
Graphics Kernal System	-	-	1/5	-	-	-	1	$ 5	$ 5
Source Code Debugger	-	1/1	-	-	-	-	1	$ 1	$ 1
Text Control Package	-	1/5	-	-	-	-	1	$ 5	$ 5
Performance Monitor	1/6	-	-	-	-	-	1	$ 6	$ 6

INTERMEDIATE

USO GIS SYSTEM

PERIPHERAL QUANTITIES

Description*	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Digitizing Tables									
Backlight (40"x60")	-	-	1/10	-	-	-	1	$10	$ 10
Hard Copy Devices									
Color Ink Jet Plotter (8-1/2"x11")	-	1/7	-	-	-	-	1	$ 7	$ 7
Graphics Terminals									
Monochrome Vector	-	2/3	1/1.5	-	-	-	3	$ 1.5	$ 4.5

* The descriptions do not necessarily represent the equipment that would be procured. They merely describe a typical system currently available.

INTERMEDIATE

Utah-Districts GIS SYSTEM

HARDWARE QUANTITIES

Description	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Central Processing Unit*									
Level D CPU (w/1MB)	-	1/7	1/7	1/7	1/7	1/7	5	$ 7	$ 35
Disk Storage									
Fixed (30MB)	-	1/5	1/5	1/5	1/5	1/5	5	$ 5	$ 25
Tape Storage									
Cartridge (6250 bpi/15MB)	-	1/5.5	1/5.5	1/5.5	1/5.5	1/5.5	5	$ 5.5	$ 27.5

* Offices to receive GIS equipment are based on the current planning schedule. The schedule could change depending on District requirements or availability of funds.

INTERMEDIATE

Utah-Districts GIS System

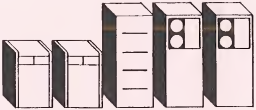
PERIPHERAL QUANTITIES

Description*	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNTI PRICE ($000)	TOTAL COST ($000)
Hard Copy Devices									
Color Ink Jet Plotter (8-1/2"x11")	-	1/7	1/7	1/7	1/7	1/7	5	$ 7	$ 35
Drum Pen Plotter (4 pen)	-	1/18	1/18	1/18	1/18	1/18	5	$ 18	$ 90
Dot Matrix Printer	-	2/2	4/4	4/4	4/4	4/4	18	$ 1	$ 18
Graphics Terminals									
Monochrome Vector	-	2/3	4/6	4/6	4/6	4/6	18	$ 1.5	$ 27

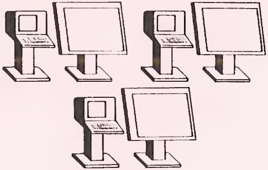
* The descriptions do not necessarily represent the equipment that would be procured. They merely describe a typical system currently available.

MINIMAL GIS CONFIGURATION

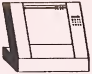
S.O.



REMOVABLE DISKS LARGE CPU TAPE DRIVES

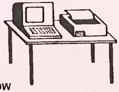


DIGITIZING WORK STATIONS (3)

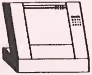


BELT-BED PLOTTER

D.O.



LOW RESOLUTION TERMINAL DOT-MATRIX HARD COPY



BELT-BED PLOTTER

R.A.O. No Equipment

UTAH BLM
GEOGRAPHIC INFORMATION SYSTEM

SUMMARY

MINIMAL GIS CONFIGURATION

GENERAL DESCRIPTION:

State Office --Large CPU without enhancements to improve performance

Districts --Drum/belt bed plotter
--Low resolution terminal and hardcopy

Areas --No equipment

COST SUMMARY - summarized in ($000)

STATE OFFICE

	0	+1	+2	+3	+4	+5	Total
Equipment	290.7	108.0	29.8	35.2	23.2	0	486.9
Procurement	12.5	30.2	42.0	48.3	54.1	57.9	245.0
WM Costs	102.5	130.0	180.0	220.0	252.5	280.0	1,165.0
Sub-Total	405.7	268.2	251.8	303.5	329.8	337.9	1,896.9

DISTRICT/AREAS

Equipment	0	22.0	22.0	22.0	22.0	22.0	110.0
Procurement	40.0	70.6	29.5	83.2	37.5	40.5	301.3
WM Costs	0	15.0	25.0	47.5	67.5	77.5	232.5
Sub-Total	40.0	107.6	76.5	152.7	127.0	140.0	643.8
Total	445.7	375.8	328.3	456.2	456.8	477.9	2,540.7

UTAH BLM
GEOGRAPHIC INFORMATION SYSTEM

DETAIL-PROCUREMENT COSTS ($000)

MINIMAL GIS CONFIGURATION

STATE OFFICE SYSTEM

	0	+1	+2	+3	+4	+5
Contract Digitizing	0.0	0.0	0.0	0.0	0.0	0.0
Data Purchase (SCS, DEM DLG)	0.0	0.0	0.0	4.0	7.0	7.0
Equipment Maintenance	4.5	20.5	29.2	31.0	33.6	35.4
Software Subscriptions	0.0	1.7	2.8	3.3	3.5	3.5
Supplies	8.0	8.0	10.0	10.0	10.0	12.0
Sub-Total	12.5	30.2	42.0	48.3	54.1	57.9
DISTRICT OFFICE SYSTEMS						
Contract Digitizing	26.0	47.6	0.0	49.7	0.0	0.0
Data Purchase (SCS,DEM, DLG)	14.0	21.0	24.5	24.5	24.5	24.5
Equipment Maintenance	0.0	0.0	2.0	4.0	6.0	8.0
Software Subscriptions	0.0	0.0	0.0	0.0	0.0	0.0
Supplies	0.0	2.0	3.0	5.0	7.0	8.0
Sub-Total	40.0	70.6	29.5	83.2	37.5	40.5
Total	52.5	100.8	71.5	131.5	91.6	98.4

(1) Funding for contract digitizing will be by users (i.e. field offices)

(2) Contract digitizing is based on having 2 X 8 hr shifts working in S.O.

(3) Equipment maintenance is based on 7.5 percent of purchase price

(4) Software subscription fees are based on 10 percent of initial license

(5) Equipment maintenance and software subscription fees begin in the year following acquisitiion.

UTAH BLM
GEOGRAPHIC INFORMATION SYSTEM

DETAIL WORKMONTH COSTS ($000)

MINIMAL GIS CONFIGURATION

WM's - STATE OFFICE	0 85	+1 86	+2 87	+3 88	+4 89	+5 90
GIS Operations Mgmt.	0.5	0.6	0.6	0.7	0.7	0.8
Digitizing	2.0	2.0	3.0	4.0	5.0	6.0
Computer Systems Mgmt.	0.1	0.3	0.5	0.6	0.6	0.6
Computer Operations	0.1	0.1	0.3	0.4	0.4	0.4
Data Base Administration	-	0.2	0.6	0.8	0.8	0.8
Applications Programing	-	0.2	0.3	0.4	0.5	0.5
Carto Management	0.5	0.7	0.7	0.7	0.8	0.8
Project Planning	-	0.2	0.3	0.3	0.3	0.3
Applications Management	0.8	0.7	0.7	0.7	0.8	0.8
Training	0.1	0.2	0.2	0.2	0.2	0.2
	4.1	5.2	7.2	8.8	10.1	11.2

WM's DISTRICT OFFICE (TYPICAL SPREAD)

	-2	-1	0	+1	+2	+3
GIS Coordination	0.2	0.2	0.4	0.5	0.4	0.3
Digitizing	-	-	-	-	-	-
Computer Oper/Mgmt.	-	-	-	0.2	0.3	0.3
	0.2	0.2	0.4	0.7	0.7	0.6

STATE OFFICE SUMMARY

0 (85)	4.1 X 10 = 41 x	$2,500.00 =	$102,500.00
+1 (86)	5.2		130,000.00
+2 (87)	7.2		180,000.00
+3 (88)	8.8		220,000.00
+4 (89)	10.1		252,500.00
+5 (90)	11.2		280,000.00
			1,165,000.00

DISTRICT OFFICE SUMMARY

0 (85)	0	= 0
+1 (86)	0.6 X 10 = 6 X $2,500.00	=$15,000.00
+2 (87)	1.0	25,000.00
+3 (88)	1.9	47,500.00
+4 (89)	2.7	67,500.00
+5 (90)	3.1	77,500.00
		232,500.00

1,397,500

MINIMAL

USO GIS SYSTEM

2/40
2=quantity
40=total cost ($000)

HARDWARE QUANTITIES

Description	0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Central Processing Unit									
Level A CPU (w/4MB)	1/158	-	-	-	-	-	1	$158	$158
Level D CPU (W/1MB)	-	1/7	-	-	-	-	1	$ 7	$ 7
Main Memory Increments									
Level A (2MB)	-	2/10	-	2/10	-	-	4	$ 5	$ 20
Disk Storage									
Fixed (350MB)	-	1/25	-	1/25	-	-	2	$ 25	$ 50
Add-on (350MB)	-	-	1/20	-	1/20	-	2	$ 20	$ 40
Removable (270MB)	1/25	-	-	-	-	-	1	$ 25	$ 25
Add-on (270MB)	1/20	-	-	-	-	-	1	$ 20	$ 20
Fixed (30MB)	-	1/5	-	-	-	-	1	$ 5	$ 5
Tape Storage									
Reel (1600/6250 bpi)	1/40	1/40	-	-	-	-	2	$ 40	$ 80
Communications									
Modem/async Com. Proc.	1/4	-	-	-	-	-	1	$ 4	$ 4
Modem/async Ports	4/.4	-	4/.4	-	-	-	8	$ 0.1	$ .8
Local/async Com. Proc.	1/4.5	-	-	-	-	-	1	$ 4.5	$ 4.5
Local/async Ports	4/.25	-	-	-	-	-	4	$ .06	$ .25
Synchronous Com. Proc.	-	-	1/4	-	-	-	1	$ 4	$ 4
Synchronous Ports	-	-	4/.4	2/.2	2/.2	-	8	$ .1	$ .8
Hard Copy Devices									
Printer (600 lpm)	1/16	-	-	-	-	-	1	$ 16	$ 16
Printer/terminal	1/3	-	-	-	-	-	1	$ 3	$ 3
Video Display Terminals									
Alphanumeric VDT	2/3	-	-	-	2/3	-	4	$ 1.5	$ 6

MINIMAL

USO GIS SYSTEM

SOFTWARE QUANTITIES

Description	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Central Processing Unit									
OS - Vendor Specific	1/10	-	-	-	-	-	1	$ 10	$10
FORTRAN 77	-	1/5	-	-	-	-	1	$ 5	$ 5
Sort/Merge	1/.5	-	-	-	-	-	1	$ .5	$ .5
Graphics Kernal System	-	-	1/5	-	-	-	1	$ 5	$ 5
Source Code Debugger	-	1/1	-	-	-	-	1	$ 1	$ 1
Text Control Package	-	1/5	-	-	-	-	1	$ 5	$ 5
Performance Monitor	1/6	-	-	-	-	-	1	$ 6	$ 6

MINIMAL

USO GIS SYSTEM

PERIPHERAL QUANTITIES

Description*	FISCAL YEAR 0	+1	+2	+3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Hard Copy Devices									
Color Ink Jet Plotter (8-1/2"x11")	-	1/7	-	-	-	-	1	$ 7	$ 7
Graphics Terminals									
Monochrome Vector	-	2/3	-	-	-	-	2	$ 1.5	$ 3

* The descriptions do not necessarily represent the equipment that would be procured. They merely describe a typical system currently available.

MINIMAL

Utah-Districts GIS System

PERIPHERAL QUANTITIES

Description*	0	+1	+2	FISCAL YEAR +3	+4	+5	TOTAL QNTY	UNIT PRICE ($000)	TOTAL COST ($000)
Hard Copy Devices									
Drum Pen Plotter (4 pen)	-	1/18	1/18	1/18	1/18	1/18	5	$ 18	$ 90
Dot Matrix Printer	-	1/1	1/1	1/1	1/1	1/1	5	$ 1	$ 5
Graphics Terminals									
Monochrome Vector	-	2/3	2/3	2/3	2/3	2/3	18	$ 1.5	$ 15

* The descriptions do not necessarily represent the equipment that would be procured. They merely describe a typical system currently available.

22. APPENDIX

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
WASHINGTON, D.C. 20240

Memorandum

To: All State Office PEC Chiefs

From: Chief of Planning (WO 202)

Subject: Use of Modeling in the NEPA Process

This report from our staff defines modeling, describes types of models, discusses the usefulness of models, and presents examples of on-going applications of models to the NEPA process. These examples are from within BLM as well as from other Federal agencies.

This material is provided for your review and use. If you would like further information on any of the applications examples, please contact this Office (Bruce Bandurski). We welcome any suggestions on useful ways to pursue this topic further. For example, we might revise this, with more practical information, and send it out as a Planning Aid.

David Williams

Enclosure

"A model is a lie which makes you see the truth."
--R.H. MacArthur

MODELING IN THE NEPA PROCESS

Introduction

This informal evaluation considers the utility of modeling in the NEPA process. In a cursory (but revealing) way, it explores how models have been used to enhance analytical and decisionmaking aspects of the NEPA process.

Modeling means various things to various people. Actually, we all "model" whenever we think. We express ourselves via sentences which are models. Often this medium (a model) is the message. It is the abstraction of reality that we use when we attempt to communicate. A model is a recording of our abstract thinking. In virtually any form, it represents our conceptual understanding of a situation.

A model is a concrete or abstract representation of something else, usually from the real world. All people use models many times a day -- even in the most routine decisions. Sometimes the model is used consciously, sometimes subconsciously or unconsciously. Though visiting England, an American might look automatically to the left as, simultaneously, he steps from the curb to cross a street. Well into the step, he may learn that his model was an incorrect representation of the real world of his present location. Hopefully, his model would be corrected in time for him to realize that looking first to the right is more safe in a location where autos are driven on the left side of the road.

As we face decisions, models play a vital part in our problem-solving on the street and in the office. Many of these models are simple. In absolute terms, all are simplistic. Study after study in recent decades has shown that, for most decisions, very few factors are considered because the human mind is incapable of handling very much detail or complexity at once. The mental models decisionmakers use contain relatively few factors. They are often extreme abstractions of the real world about which a decision is being made. One of the dangers in using such simplified mental models is that they tend to "drift" in the face of new information fed back to the decisionmaker. We process the new information and incorporate it into our model, thus changing the model, often without realizing that the change has taken place.

The course of most problem-solving can be modeled in four steps. (1) When we establish purposes or goals we do so by relating to a "model" of the desired state of the real world system of which we are part. (2) When we analyze (in seeking alternative resolutions of a problem), we rely on an assessment model which depicts relevant situations inside and outside the system that affect how far the state of the system deviates from what we want. (3) Synthesis models are what we devise when we begin narrowing the range of alternative solutions to a problem; in creating these models, we more closely approach our impending decision by comparing their system states with that expressed in our goal statements. And, (4) as the last stage of the problem-solving process, we decide and implement by a mental model or via letting others know what "model" we see as the solution.

In a formal sense, "modeling" means documenting our abstract thinking. Models can take the form of three-dimensional objects (e.g. working models, scale models). They can take the form of two-dimensional depictions (e.g. maps, engineering and architectural drawings). Other models are even more abstract representations of real world interrelationships (e.g. matrices, box-and-arrow diagrams), and some take the form of mathematical equations that quantify those interrelationships. Computer programs that solve those equations are also models.

Developing and using qualitiative and quantitative models of natural resource relationships, or parts of ecosystems, in order to reach better decisions about resource management is an attempt to capture the mental models more explicitly and concretely. In such documentation efforts, resource specialists and decisionmakers specify the essentials of their mental models. These specifications are recorded on paper or in a computer, and the logical consequences of man's activities within the setting are examined through simulation with those models. If these consequences are unacceptable or not believable, the model is examined carefully to determine where the "mental model" input might be in error. If new information is available, the model is changed to accommodate that information explicitly, rather than implicitly as is often done when only mental models are used.

Such resource management models are, however, a reductionist approach to problem-solving. Typically, they enable a summing of resource concerns; but they do not enable the full recognition of interactions that result in systems products which are more than sums. If the problem needs a systemic solution, piecemeal resource-by-resource modeling may not provide it.

Man/environment (human ecosystem) modeling can serve the purpose of helping resource specialists, generalists, and decisionmakers to organize their thoughts, their information, and their mental models into a logical structure that can then be examined much more explicitly and easily for missing information, gaps in logic, or hidden assumptions. Even if the holistic model is not very accurate in its predictions, it contributes greatly to the understanding of how the ecosystem functions and what are the important elements of that system. This fact alone is of great importance to the decisionmaker, for it can help him or her identify and focus on the heart of a decision quickly and with greater assurance than other approaches.

Broad mandates such as the National Environmental Policy Act "should make the federal administrative agencies a paradise for both modelers of strictly natural systems and for modeling that mixes natural and social science. Here should be the real opportunity to support the research that will allow one to understand a system like a vast national forest or the comprehensive workings of a waterway, and modeling should be well suited to predicting and examining the effects on natural systems of purposeful or accidental human intrusions. Unfortunately the agencies have not yet fully exploited these opportunities."[1]

I. Modeling and the NEPA Process
(including Findings of this evaluation)

NEPA states, as one of its purposes, "enrich the understanding of the ecological systems and natural resources important to the Nation". Its declaration of national environmental policy stresses the goal of obtaining a balance between technological advances and natural life-support systems by addressing "the critical importance of restoring and maintaining environmental quality" for "productive harmony" under which man and nature can fulfill the social, economic, and other requirements of present and future generations.

The means of achieving this goal, as set forth in NEPA, are derived from improvements in science and engineering. One means is a "systematic, interdisciplinary approach" insuring the integrated use of sciences and the design arts. Another is the initiation and utilization of "ecological information in the planning and development of resource-oriented projects". Models, particularly systems models, seem to promise a way of melding these scientific approaches so that they are useful to the decisionmaker in fully embracing the important issues. Actually, systematic development and invalidation of models is the scientific method. And, the NEPA process surely can derive benefit from more grounding in science.

[1] Angus Macbeth. "Modeling in the Context of the Law", in Ecosystem Modeling in Theory and Practice, edited by C.A.S. Hall and John W. Day, Jr.; John Wiley & Sons, New York, N.Y., 1977.

NEPA also exhorts Federal agencies to use "all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources". The use of "all practicable means" to improve environmental management includes the use of monitoring when science is relied on in making decisions. This is so because all science is probabilistic. If it is to be relied upon via models, it must have a built-in check with reality.

In its most recent annual report, Environmental Quality 1981, the Council on Environmental Quality noted, "Gaps in the data base, an inability of the models to integrate the various sectors (such as population, food, fisheries, water, energy, minerals, and climate), lack of consistency and compatibility vis-a-vis the forecasting techniques used by different federal agencies, and absence of interaction among the modelers and forecasters in different parts of the government and the private sector have been cited as significant deficiencies. Global 2000 and other recent global trend reports differ in their assumptions, recommendations, and perceptions, but they do identify common concerns about the future of the global environment. They all address world-level changes that have become increasingly visible in recent years: the growth of human population, the transformation of the earth through human development, and the increasing range and quantities of materials and energies required to support that development. Whatever their limitations, they have stimulated the thinking of millions about the future and about the social and political challenges it offers."

Considering the alternatives, what do we have other than models (in our minds or on paper) that can offer systematic bases for our governmental problem-solving? As NEPA exhorts, we need to employ a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts (engineering, architecture, etc.) in planning and in decisionmaking which may have an impact on man's environment. How often do we need to be reminded that NEPA -- like the Constitution -- shows the way (provides the working model) when it declares that "it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans."

NEPA provides a model of a desirable system state for America, a goal model. The Act is not just procedural in essence. It makes little sense except when applied with reference to a context -- a model of the way we as a Nation would hope things and interrelationships to be. NEPA specifies goals the achievement of which is attainable largely through the applied science and art of good government.

Environmental management is viewed in an international context in NEPA. The Act recognizes that much environmental problem-solving necessitates international cooperation and international sharing of data and information. The utility of models for such environmental analyses is a subject of worldwide interest. Table 5A is illustrative of the extent to which some sort of modeling was relied on in 98 case studies which were investigated by Environmental Resources Limited and reported in a recent paper[2] by L.W. Canter.

Modeling used properly can represent the best of scientific method. Science's use, in government as elsewhere, must be tempered and upgraded by carefully arranged "feedback". This feedback is information provided through monitoring of any important forecasts. These are forecasts that are, in turn, based on science and art applied in the decisionmaking process. NEPA is a policy act, predicated on these principles.

In a decisionmaking context, then, modeling and monitoring are thoroughly linked when it is important to reach desired goals. <u>This</u> evaluation will be limited, though, to a consideration of models -- the attendant use of monitoring (invalidation/validation) being implicit.

[2]L.W. Canter. "State-of-the-Art in Impact Assessment," presented at the Wildlife Management Workshop, Colorado State University, Fort Collins, Colorado, January 18-22, 1982; p. 12.

Summary of Predictive Techniques Used in Case Studies
(Environmental Resources Limited, 1981)

Effects (1)	No. of Examples of Use of Techniques			Estimate of No. of Different Techniques
	Modelling	Survey	Total	
Prediction of Sources:				
Emissions to air	13	-	13	8
Discharges to water	2	-	2	2
Emissions of sound	4	-	4	2
Quantities of waste	1	-	1	2
Release of substances	-	-	-	1
Release of radio-activity	3	-	3	-
Physical characteristics	2	10	12	2
Accidents	4	-	4	6
Natural disasters	1	1	2	4
Use of resources	1	-	1	2
				1
	31	11	42	28
Prediction of Effects on:				
Soil	2	-	2	2
Landform	3	4	7	6
Hydrological	15	3	18	9
Climate	1	-	1	1
Air quality	32	1	33	18
Water quality	19	5	24	12
Noise environment	26	-	26	17
Visual environment	11	16	27	7
Landscape ecology	-	3	3	1
Recreation	-	10	10	2
History & Culture	-	7	7	2
Scientific and natural resources	-	7	7	2
Local amenity	4	17	21	5
Plants & Animals	5	24	29	4
Agriculture	-	17	17	2
Forestry	-	14	14	3
Fisheries	-	1	1	1
Minerals	-	2	2	2
Water resources	-	1	1	1
Property	-	11	11	2
Public Health and Safety	5	7	12	5
	123	150	273	105

(1) Based on analysis of 98 case studies.

FINDINGS OF THIS EVALUATION

1. For decisionmaking aids, BLM and some other land-managing agencies are beginning to make good (effective and efficient) use of partial (reductionist) models of their environment and of anticipated impact of their actions on that environment. [These are models that represent concerns of individual programs or which address associated values which provide only part of the picture of overall system functioning.] It appears, however, that insufficient effort is being put forth to square these models with reality through post-decision monitoring. Follow-up plans and provisions are made (typically more than half the time by BLM and the Forest Service) to undertake reanalysis and monitoring after implementation of significant actions, but seldom are those plans and provisions fully realized.

2. For decisionmaking aids, BLM and other land-managing agencies have not yet made good (effective and efficient) use of quasi-comprehensive (holistic) models of their environment and of anticipated impact of their actions on that environment. Consequently: (1) managers who have responsibility for balancing a full set* of resource values (such as those acknowledged in FLPMA) are not being provided staffwork which assists them in anticipating the net effect of various alternatives for system management, and (2) there is little opportunity to implement fully the mandate of NEPA to "enrich the understanding of the ecological systems [with man recognized as an integral operant in these systems] ... important to the Nation".

*The interacting, interrelating effects of federal agency programs upon land and resources was clearly demonstrated in Senate hearings (24 March and 28-29 April, 1970) on the National Land Use Policy Act of 1970 (S. 3354). These hearings highlighted the need not only for policy coordination at high political levels; they also clarified the essential interdisciplinary character of environmental impact problems and of the scientific capabilities needed to address them.

II. Modeling, NEPA, and the BLM

This evaluation comprises one of a series of subtasks, pursuant to a Departmental MBO task. It is aimed at streamlining the NEPA compliance process and improving program management. This task is, in turn, part of the Departmental objective enunciated by the Secretary to "enhance the NEPA process to make it a cost effective and integral part of the decisionmaking process of the Department of the Interior and enhance the value of EIS's to the public".

In formulating this MBO task in 1981, the Bureau of Land Management recognized a potentially greater role for modeling. Modeling of various sorts enables depictions of man/environs relationships -- relationships crucial to the understanding of ecological systems important to the Nation. It also enables various "shorthand" depictions which are sometimes the fastest and most complete ways of communicating information concerning man's environment and man's effects on environment. In short, models offer real promise for streamlining. This fact has become evident to more-and-more BLM personnel through their involvement in the NEPA process. [Those interested in a "short course" on understanding the applicability of models to the NEPA process are referred to Section 14 (Advanced Techniques) of BLM's NEPA Shortcourse Syllabus, a copy of which was provided to each State, District, and Area Office in 1981.]

Others have recognized this increasing role for models. At the end of August 1982, the BLM received an advance copy of a final report to the National Science Foundation, based on Foundation Grant PRA-79-10014. The report is entitled "A Study of Ways to Improve the Scientific Content and Methodology of Environmental Impact Analysis". Its principal focus is on the question: How can the scientific content of environmental impact statements be made more useful to policy makers and increase the validity and reliability of environmental decisions? This report which surveyed BLM field employees (and field employees of the Forest Service, Corps of Engineers, and Soil Conservation Service) identifies factors limiting their ability to implement NEPA. It concludes, "Factors that agency employees judged to be most limiting of ability to implement NEPA were (1) time constraints, (2) availability of funds for environmental studies and research, (3) the state-of-the-art of systems modeling, and (4) available manpower". These factors are, of course, interrelated; but Factor 3 is of particular interest in this evaluation. We anticipate that improvement in Factor 3 might well lead to considerable relief from Factors 1 and 4.

Our informal evaluation covered a small sample of modeling activities of offices with which we have had particularly close

contact from our "center" of modeling expertise -- Peter T. Haug, Systems Ecologist. Dr. Haug was stationed in Ft. Collins, Colorado, during the period of our conduct of this evaluation (and before). As his supervisor, I asked his assistance in conducting this evaluation. His technical expertise in the modeling field is especially valued, but I expect that his abilities in communications will be just as critical in determining the outcome of this MBO item.

In Ft. Collins, Dr. Haug was active in keeping apprised of and contributing to work which is at the state-of-the-art level in ecological modeling. There he stayed in close touch with his former major professor, George M. VanDyne, who was a recognized authority on the subject of modeling. [BLM has used Dr. VanDyne's work in formulating its rangeland management program. ~~A recent paper by VanDyne is, therefore, appended (Appendix 1) to this evaluation for those interested in continuing to follow his work. The appended paper is an apt summary of the state-of-the-art of systems ecology and explicates the crucial role of modeling.~~]

Appendix not included

Ecological modeling is gaining momentum, especially where it has clientele facing complex and tough decisions dealing with the man/environment interface. This MBO item, which we formulated more than a year ago, appears well-timed. Just prior to the field interview part of this endeavor, Dr. Haug presided over a session of the "Third International Conference on State of the Art in Ecological Modelling" held in Ft. Collins, May 24-28, 1982. That conference was, in turn, shortly preceded by an interagency agreement (signed in April and May) between the BLM Wyoming State Office and the USFWS Western Energy and Land Use Team for further cooperation in developing BLM's proficiency in operating a computerized geographic information system (GIS). From what we saw in the Bureau's Cheyenne office, this approach to modeling has been of real aid in completing coal data analyses. The interagency cooperation in increasing BLM's ability to use such computer technology was enhanced by inclusion of a role for the Bureau's Denver Service Center as a technical coordinator to maintain compatibility with extant BLM GISs.

In the Wyoming State Office, we were also introduced to the utility of TAPAS, a model that addresses a Topographic Air Pollution Analysis System. Particularly impressive, in this case, was the fact that -- rather than prolonging a critically-timed analysis which recently confronted the Office -- the model was very instrumental in providing necessary answers in much less time than would otherwise have been possible and at a savings of tens of thousands of dollars that otherwise would have been considered a necessary expenditure. Both line and staff seemed delighted with its effectiveness and efficiency in enhancing the probability of an environmentally informed decision.

Earlier than this field visit phase of this evaluation [shortly after CEQ's NEPA Regulations were promulgated with inclusion of a mandate to consider energy requirements and conservation potential of various alternatives and mitigation measures, 40 CFR 1502.16(e)], Haug and I were involved in encouraging the use of expertise of the Colorado School of Mines Research Institute to devise a generic approach to net energy analysis.* This led, eventually, to the development of an "Energy Analysis Handbook for Preparation of Oil Shale Development Environmental Impact Statements" completed in March, 1982, for BLM's Colorado State Office. The "model" illustrated, therein, comprises a general methodology of trajectory and modules which is not so complex as to require sophisticated computer modeling. This model can be presented graphically and numerically so that lay persons can interpret it. As it can address different types of energy systems with consistent logic and data, we expect to see it used with increasing frequency and utility in the Bureau's Colorado offices and elsewhere.

The Oregon State Office of the BLM has had long acquaintance with models in implementing its timber management program. As documentation of this fact and to provide information to those interested in such use of models, we have appended (Appendix 2) to this evaluation pages from five environmental impact statements prepared in that Office. In each of these decision-support documents is described a computerized forest simulation model used to determine the highest sustainable allowable cut for each management alternative. The model permits alternative plans to be evaluated on the basis of their respective production levels and fiscal requirements.

Headquarters offices of the Bureau also rely on models in planning and accomplishing their work. In fact, models often serve as devices for explicit documentation of agreements reached between headquarters offices and the field. An example of this device which communicates a planned scope of analysis (to headquarters and to the Oregon State Office) is the September 1982 "Working Draft Preparation Plan, Jackson/Klamath Sustained Yield Units, Fiscal Year 1984 Timber Sale Environmental Assessments". This working model provides the basis for communications _within_ the Medford District concerning the desired approach to environmental analysis. It also serves well to alert the State Office and the Washington Office to the planned approach.

*Essentially, this is an accounting of energy inputs and energy outputs. It is used to help answer the question: "How much energy does it take to produce energy?"

III. Other Agencies' Modeling with NEPA Process Potential

USDA Forest Service, Land and Resource Management Planning Systems

J.W. "Bill" Russell, Assistant Director for Land Management Planning, explained the Forest Service approach to planning. Basically they are using three types of models, each for a different purpose: simulation, optimization, and input-output.

The heart of the approach is FORPLAN, a linear-programming (LP) FORest PLANning model. A memorandum from the associate chief of the Forest Service states that: "The Forest Planning Model will be the required primary analysis tool for the Forest Plans. The Forest Planning Model is a linear programming package for resource allocation and activity scheduling, with linkages to program planning. Resource allocation and activity scheduling determine when, where and how specific practices or activities (i.e., management prescriptions) wil be applied to the land. Allocation is affected by the ability of the schedule to meet periodic targets, and scheduling is affected by assignment of land to management prescriptions and intensities given it through the allocation process. While allocation and scheduling may be separated for operational reasons, they must be modeled as parts of a single process."

The input-output model is IMPLAN. It is used to evaluate the socioeconomic effects of resource allocation and scheduling as determined by FORPLAN. The output from IMPLAN can be fed back into FORPLAN to establish new constraints, as needed, when certain socioeconomic thresholds are exceeded.

The simulation modeling is the newest and least-tested part of the approach. The Forest Service is currently seeking some sort of simulation methodology to enhance communication within the interdisciplinary planning teams and to assist teams in devising feasible management prescriptions. Feasibility, in this case, means acceptable resource production levels and acceptable levels of environmental impacts on the forest.

They are also thinking about designing and implementing long-term monitoring procedures, but this is currently of lower priority than developing a simulation approach to forest prescriptions.

USDI Fish and Wildlife Service, Western Energy and Land Use Team (WELUT)

Adaptive Environmental Assessment Group (AEAG)

Richard "Ike" Ellison described some of the recent successes his group has had. The AEA approach was developed over 20 years by C.S. Holling of the University of British Columbia. The AEA group at WELUT was training by Holling and his associates and has been applying the technology since 1978.

Their Summary of Adaptive Environmental Assessment Applications states, "Each assessment is based on a series of multidisciplinary/public participation briefings, scoping meetings, simulation modeling workshops, and follow-up technical and policy meetings."

Clients of this group have included Geological Survey; Fish and Wildlife Service (California Water Policy Center and Sacramento Area Office); Special Assistant to the Secretary of the Interior and the North Dakota Natural Resources Coordinator; FWS National Power Plan Team; FWS-WELUT Habitat Evaluation Procedures Group; and the Environmental Protection Agency.

Briefly, the approach consists of bringing together representatives of competing and/or conflicting interests in one, two or more workshops to evaluate the environmental effects of different types of development. ("Environmental" is used here in the NEPA sense to include social and economic considerations, as well as those of physical and life sciences.) Group dynamics and consultation are used to identify fundamental interactions and relationships in the human environment under consideration.

Skilled modelers then use input from the participants to develop a simulation model of the problem. The model is refined through periodic workshops or other types of interactions between the modelers and representatives of different interests. Participants continue to monitor the model development in order to maintain their levels of understanding, credence, and belief in the model. The model then is used to analyze different scenarios proposed by the completing interests and to help decisionmakers reach decisions. The approach is well documented in Holling's 1978 book, Adaptive Environmental Assessment and Management.

Ike said that this approach has been used in 60 projects worldwide to date.

Habitat Evaluation Procedures Group

Mel Schamberger and Henry Short described the Habitat Evaluation Procedures (HEP) and how they are being implemented. These models combine quantitative measurements and estimates about a given habitat into a Habitat Suitability Index for different levels of wildlife populations. The HEP also permit the user to convert habitat data into data useful for economic analyses.

A recent paper by Schamberger and William B. Krohn entitled Status of the Habitat Evaluation Procedures states: "The U.S. Fish and Wildlife Service has developed, and is now implementing, the Habitat Evaluation Procedures (HEP). This paper provides an update on the current status of HEP, which was developed through cooperation with the U.S. Army Corps of Engineers (COE), the U.S. Soil Conservation Service (SCS), and the U.S. Bureau of Reclamation (BR), with guidance and interest from several State agencies and National conservation groups. HEP now consists of several components; (1) an accounting procedure; (2) a method for determining habitat quality; (3) a method for using habitat values to derive economic values.

"The first component, the HEP accounting procedures, is a method of combining habitat quantity (area) and habitat quality (an index) into Habitat Units (HU). The accounting portion of HEP permits the evaluaiton of the impacts of development alternatives on habitat [quantity or quality]* over time or space. HUs are compared for existing and predicted conditions in order to estimate changes in potential habitat for selected evaluation elements, such as individual species, species groups, species life stages, or life requisites. Standards have been published to provide guidance in the development of species-habitat models that can be used with HEP or other habitat evaluation methods. HEP is being applied to four COE and three SCS demonstration projects to determine institutional and technical acceptability. [In addition, the Fish and Wildlife Service applied HEP on about 100 sites in 1982.]* At the same time, special studies have been initiated to improve the scientific credibility of the system. In an effort to ensure uniform application, a Nationwide training program was initiated in March, 1980. The 1980 edition of HEP provided detailed guidance for species selection and for the development and use of habitat models to quantify habitat quality. A major concern of both reviewers and users has been that any model used must be documented and have some degree of verification, such as field testing, expert review, or comparison with population data. HEP has potential as a standard habitat evaluation method. The continued application of HEP, combined with refinement of HSI models, can lead to better communication between developers and wildlife managers, improved efficiency, and better resource decisions."

*Modifications supplied by Schamberger.

Other work being performed under the auspices of the HEP Group include application of the guild concept within the general HEP approach. A paper by Short and Kenneth P. Burnham, Technique for Structuring Wildlife Guilds to Evaluate Impacts on Wildlife Communities, "describes a technique for ordering wildlife information according to physical strata and vegetative structure so that a variety of statistical analyses can be accomplished. Individual wildlife species are assigned to cells in a species-habitat matrix on the basis of feeding and breeding activities within physical strata in representative types of vegetative cover; the cells within the analyses are thus based on the areas that individual species occupy within the species-habitat matrix. Computer graphics are used to represent the structure of wildlife communities and cluster analysis routines are used to describe the potential wildlife guilds that may exist in different vegetative communities. Different numbers of wildlife guilds will occur in different types of cover within a potential natural vegetation type. Furthermore, the number of wildlife species and presumably also of wildlife guilds present within a type of cover is modified by physical attributes of the vegetation within that cover type. The products of this analytical technique may be suitable for evaluating habitat quality, impact assessments, regional inventories and assessments of wildlife resources, and land-use planning activities."

This is because the guilding technique associates wildlife species with the structure of habitat expressed in terms of habitat layers. Because most land-use change affects layers of habitat, the manager is immediately able to identify the wildlife species that will be affected by proposed land-use changes.

Specific applications for which HEP is suitable include:

1) Impact assessments
2) Air photo interpretation studies
3) Fish and wildlife habitat inventories
4) Fish and wildlife mitigation studies
5) Studies in which numerous areas are being evaluated in a very general way, such as early planning studies
6) Management studies of selected species
7) Studies to relate changes in fish and wildlife habitat variables with changes in expected populations
8) Relating habitat to economic and recreation values

A second important paper, a techniques review, entitled Estimating Wildlife Habitat Variables by Robert Hays, Cliff Summers, and William Seitz, describes 35 techniques for estimating variables commonly used as input to habitat models for terrestrial wildlife species: "Each description includes explicit directions for use, and information about required equipment, cost to apply, accuracy, and conditions under which it is appropriate to be used."

Instream Flow and Aquatic Systems Group

In the absence of the group leader, Clair Stalnaker, we met with Fred Theurer. In resource management, mathematical modeling has perhaps been longest used, and is thus best developed, in the broad area of water resources. These include hydrological models used by civil engineers and watershed analysts, as well as habitat models used by fisheries biologists. Some examples of specific applications include the use of nonlinear optimization for planning and design of multipurpose retarding structures (earth dams) and an economic evaluation program for assessing flood damage on watershed.

Theurer called our attention to the following comments by Joseph W. Haas, deputy chief for natural resource projects in the Soil Conservation Service, delivered at the 1980 Symposium on Unified River Basin Management. They certainly seem relevant to both the spirit of NEPA and this survey of modeling applications:

"My central theme . . . will be a plea for intensified and premeditated cooperation and coordination at all levels of government and all levels of professional organizations and universities. We have entered an era of technical sophistication and institutional complexities that is unprecedented. With the aid of computers, planners can analyze nearly infinite numbers of alternatives. But agencies with specific missions and groups with special interest can usually find something they don't like about each of them. Still more unfortunate is the fact that many of the analyses, although mathematically accurate, are based on meager or statistically unrealiable basic data."

Theurer provided us with a report by the Office Technology Assessment entitled Use of Models for Water Resources Management, Planning, and Policy. It states: "This assessment is intended as a guide for Congress on the potential to develop and use mathematical models to more effectively and efficiently analyze the Nation's water resource problems. Policy options are presented for improving the use of these tools within both Federal and State water resource agencies.

"Mathematical models are new technologies that are increasingly being used for water analysis. The Office of Technology Assessment (OTA) focused on mathematical modeling as a means of assessing the broader issue of our ability to analyze and plan courses of action to deal with current and long-range water problems. OTA did not investigate the more traditional forms of water resource analysis that are being replaced by mathematical models, or the less commonly used physical models."

"The technical capabilities of models vary greatly among the water resource issues analyzed in this report; however, the assessment finds that models capable of analyzing many pressing water resource issues are currently available, and have significant potential for increasing the accuracy and effectiveness of information available to managers, decisionmakers, and scientists. Institutional constraints to model use, including lack of information about available models, lack of training in model use and interpretation, lack of communication between decisionmakers and modelers, and lack of general support services, are identifed as major impediments to increased model use for water resource analysis."

This OTA report is getting widespread attention for a subject generally regarded as so sophisticated that the public would have little interest. On September 8, 1982, The Washington Times carried a three-column article (Appendix 3) about OTA's report on modeling. It concluded with findings by OTA that are congruent with what we noted during this evaluation: "Models tend to be built on an ad hoc basis, in response to immediate problems, rather than as a result of integrated planning. In the absence of any comprehensive model development and support strategy ... federal agencies are often unresponsive to state and federal problem-solving needs ..."

More specifically, Theurer and Keith Bayha described a unified river basin management model in an article entitled Instream Fishery Resources in Unified River Basin Management. It states: "Unified river basin management is the integration of all analyses and decisions affecting the management of all land and water resources within a well defined hydrologic area so as to best protect and serve society today and for the future. Good management requires three levels of planning studies: (1) Level A - broad framework planning to recognize long term needs, (2) Level B - preliminary studies of selected areas with complicated problems focusing on middle term needs and (3) Level C - detailed analysis for program and project implementation to satisfy short term needs. Unified river basin management is possible only if all the concerned land and water management agencies and related institutions - government entities, research universities, and the private sector - embrace the concept.

"A comprehensive conceptual model is presented that fully integrates instream fishery resources in unifed river basin management. Recent methods of instream fishery resource evaluations are highlighted. Case studies demonstrating the practicality of these methods are summarized. Additional model development needs are identified. Interdisciplinary team work is shown to be necessary in planning and implementing any unified river basin plan. Inter-institutional cooperation is identified as necessary to develop the technology for unified river basin management."

Rapid Assessment Methods Group

We met with Duane Asherin, Don Hunter, and Sam Williamson. Hunter works as an interface between this group and the BLM. BLM offices that have used this technology include Miles City DO, Casper DO, Dickenson DO, and the Meeker RA. The Map Overlay and Statistical System (MOSS) is a geographic information system that is up and running at the Denver Service Center and in the Wyoming SO. It is also being used by the following state offices: New Mexico, Oregon, Colorado, Montana, and California.

Basically, the system is a geographic data base containing all types of data, from wildlife to weather. Map overlays are available at many different scales and levels of resolution, once the basic data are entered into the system. These different combinations of overlays can be used to identify potential land use conflicts in planning and natural resource management. Its use ranges from coal and oil shale activity planning to general land use planning.

Systems Applications Group

Jack Gross described the activities of his group as follows. They no longer use classical time simulation models, but have replaced them with decisionmaking models. They have overhauled the adaptive environmental assessment methodology into a new framework and extended it from policy to include more practical applications, such as problem analysis, goal-setting, strategic planning, and tactics or tasks.

This group has developed processes for gathering and integrating information to identify issues, conflicts and alternative solutions, and compatibilities or opportunities. Geographic information systems are used to help in policy analysis, problem analysis, and goal-setting for regional resource planning. Annual work plans incorporate strategic planning and tactics, which cover time, manpower, money, and location.

Their CARP and COOT forms were designed to record data uniformly and accommodate the problem of data heterogeneity. They record data about actions (Action Information) and resources (Biological Resource Information). COOT is Collection and Organization of Options and Tasks, and CARP is Comprehensive Analysis of Resource Programs.

Once all data are recorded, they are put into a computer data base. The geographic information system then is used to identify potential resource conflicts and generate different resource options for management. A Boolean algebraic approach allows users to generate different combinations or sets of choices, using AND-OR logic.

Issue trees are used also to keep track of decision points in a series of potential decisions leading to scenarios of future states. These states can range from a worst to a best case, with intermediate states along the way. The issue tree is the analytical structure that enables the decisionmaker to keep track of complex arguments. This portion of the system is ITSA, Issue Tree and Scenario Analysis, which is used after data are collected and organized via CARP and COOT.

Rocky Mountain Forest and Range Experiment Station

Dixie Smith, Deputy Director, spoke with us in general about the use of models. He mentioned the fire model developed by Peter Roussopoulos and the Beaver Creek timber growth and yield model at Flagstaff, as examples of successful use of models.

Tom Hoekstra, leader of the Land and Resource Management Planning Group, provided insights into how his group was developing models to predict resource production and response under alternative management practices. They are working toward a multi-level modeling structure (NAMM) designed to generate forest and range management alternatives at the forest, as input to FORPLAN, and at the regional and National levels for non-National Forest owners as input to NAMM, to be completed in time for the 1990 assessment. This approach is a modeling structure that should combine ecological, economic, and social analyses in order to define opportunities to improve the future renewable resource situation.

Greg Alward discussed the capabilities of IMPLAN, the input-output model he developed, and how it is used in conjunction with FORPLAN to assess the socioeconomic implications of the forest planning prescriptions generated by FORPLAN.

Concluding Remarks Concerning This Aspect of our Evaluation

It appears that the state of modeling in other Federal agencies is healthy, and their use of models appears to be growing.

IV. Looking to Long-term Needs for Modeling

As we noted in our Findings on page 6, BLM and other land-managing agencies seem to have a good start in the direction of efficient and effective use of reductionist models -- those dealing with selected environmental components and their dynamics.

It is especially in the realm of holistic modeling that more emphasis needs to be placed if decisionmakers in land-managing agencies are to be better served by their staffs. The manager needs to know the net result of his decisions on the state of the setting that he is responsible for. This is true whether the decision is made within the national level of government or at an individual level.

Many environmental problems in which the Bureau has a stake are not amenable to piecemeal solutions. As an essayist noted in Audubon Magazine, ""Society has grown so large and interconnected that it no longer articulates at national boundaries. Deforestation in the Amazon can affect climate in Iowa. Hunger in Laos makes politics in Moscow. The momentum of events can leave us witless. ... [L]eaders ... are particularly worried by the government's inability to read ... trends. The Global 2000 Report warned, "The executive agencies of the U.S. government are not now capable of presenting the President with internally consistent ... trends in population, resources, and environment."[3]

Several bills now before Congress call for establishment of an improved foresight capacity. As noted earlier in this evaluation, the National Science Foundation-sponsored study of the use of science in the NEPA Process has pointed up the present inattention of agencies of the Executive Branch to conceptual frameworks for analysis that would enable coherent environmental management from the Federal level. Of late, the Bureau of Land Management has made some small inroads on this problem of inattention to whole systems analysis. In its system for environmental management, the Bureau took an initial step by designating a niche for "Modeling", including holistic modeling for decisionmakers. The evaluation we have just completed has made us even more cognizant of the problematic void that is posed by the absence of a "general model, theory, or coherent methodological approach"[4] for implementation of the National Environmental Policy Act and related law.

[3]Peter Steinhart. "Looking Ahead," Audubon Magazine, September 1982, Vol. 84, No. 5; p. 6.

[4]Lynton K. Caldwell et al. "A Study of Ways to Improve the Scientific Content and Methodology of Environmental Impact Analysis", Final Report to the National Science Foundation on Grant PRA-79-10014, 1 August 1982; pp. 82-83.

V. RECOMMENDATIONS
and Supportive Conclusions

1. AS THE SECRETARIAT HAS EXPRESSED ITS INTEREST IN MAKING THE NEPA PROCESS COST-EFFECTIVE, THE BLM AND DEPARTMENT LEADERSHIP SHOULD ENCOURAGE APPLICATIONS OF MODELS WHICH CONTRIBUTE TO THAT GOAL.

2. INFORMATION ABOUT MODELS THAT HAVE PROVED THEIR UTILITY IN THE NEPA PROCESS SHOULD BE STORED AND MADE ACCESSIBLE IN A BUREAUWIDE "EXPERIENCE BANK".

With relatively little expenditure of effort, it has been easy to ascertain that models of various kinds are making important contributions to the effectiveness and efficiency of some BLM decision processes. The same can be said concerning the use of models in other agencies having missions analogous to ours. In important cases, the models being developed and used in the NEPA process have helped interested parties understand the involved values, have cut costs, and have contributed to the making of timely decisions. These indicators of the effectiveness of a decision strategy -- along with such other indicators as validity, reliability, flexibility, and acceptance -- should be used in arriving at conclusions about the merits of encouraging further modeling.

Models and their documentation/availability can do much to save time and money compared to what is now being expended in ad hoc approaches to decisions that are intended to be supported by the NEPA process. In a recent study of the Bureau's EISs (and those of other agencies), close to 80 percent were found to lack any discussion of a general methodology that guided the overall task. That same study, funded by NSF, disclosed, ""No discussion of the use of a "systems approach," "systems modeling," "whole systems analysis," or some similar conceptual framework could be found in any of the EISs ...""

Despite that finding, there is evidence in the field that the coherent "model" we are developing in BLM for NEPA work holds real promise for streamlining our environmental analyses while elucidating the overall context for decisionmaking. Instruction Memorandum No. WY-82-352 (dated June 22, 1982) includes an appendix (Appendix 6) which displays worksheets that were developed specifically to organize -- as part of a general coherent methodology -- the gathering, presentation, and utility of data in environmental analyses. That appendix compares this to earlier methodology of that office and finds its real potential for cost and time savings and for true assistance to informed decisionmaking.

Data Dependency Matrix
Participating Individuals

Name	Organization	Phone (FTS)	Subactivity
Bob Randolph	UT 921	588-3110	4111, 4112, 4113, 4122, 4131, 4132, 4133, 4134
Ed Baack	UT 941	588-3015	4711, 4712, 4714
Kent Biddulph	UT 933	588-3136	4410, 4322, 4331, 4332, 4333
Lillie Hikida Orval Hadley	UT 942 UT 942	588-3078	4211, 4212, 2300, 4220
Roger Erb Phil Parks	UT 940 UT 940	588-3017 588-3018	4360, 4610
Mel Staheli	UT 940	588-4036	4342
Ross Workman	UT 943	588-3034	4500
Bill Wagner	UT 932	588-3125	4341
Jens Jensen	UT 932	588-3124	4311, 4321, 4322, 8100, 4352

Assumptions
for
Data Base Size Estimates

Theme	Coverage	Comments
Physiographic		
Land Forms	N/A	The same as geomorphologic
Slope	Federal lands	Derived from DEM data
Aspect	Federal lands	Derived from DEM data
Contours	Federal lands	Derived from DEM data
Elevation	Entire State	DEM data-based on a 30 meter grid
Drainage Patterns	Federal lands	Includes drainage basin boundaries
Climatic		
Climatic Trends	N/A	Low priority - data not readily available
Air Quality Mon.	Site specific	Based on the number of monitoring stations
Weather Monitoring	BLM surface	Low density data theme
Growing season	BLM surface	Derived data - to be developed later
Precipitation	BLM surface	Low density data theme
Wind	BLM surface	Low density data theme
Temperature	BLM surface	Low density data theme
Humidity	Federal lands	Evapotranspiration for fire management
Photoperiod	N/A	Derived from other data when needed
Lightning	Federal lands	Interfaced with the lightning detection system and elevation data on a one square mile grid
Biotic		
Land Cover	N/A	The same as vegetation
Vegetation	Federal lands	.58 MB/QUAD based on soil figures
Habitat sites	Entire State	Includes 10-15 different species
Range sites	N/A	The same as soils
Woodland sites	BLM forest land	Includes P/J woodlands
Vegetation (Historic)	N/A	Low priority - data no readily available
Vertebrates	N/A	The same as habitat site
Invertebrates	N/A	Low priority - data not readily available
Livestock	BLM & Some FS surface	Data is primarily allotment boundaries
Feral animals	Less than 1/2 BLM surface	Primarily wild horse areas
Paleontologic	Half BLM surface	May include some BLM subsurface also
Archaeological	Federal lands	Includes both site and survey data

Theme	Coverage	Comments
Abiotic		
Geologic	Entire State	High density data theme
Geomorphologic	Entire State	
Leasable minerals	Equal to entire State	Many types of minerals, each covering limited areas
Locatable minerals	Equal to entire State	Many types of minerals, each covering limited areas
Soils	Federal Lands	May also include some adjacent lands
Surface water	Entire State	
Ground water	Entire State	Occurrence and quality
Watershed condition	BLM surface	
Administrative		
Land net	Entire State	Township/range/section lines
Ownership	Entire State	Includes surface and subsurface
Cad. survey plats	N/A	The same as land net
Transp. network	Entire State	Major roads, railroads, airfields, etc.
Govt. Jurisdiction	Entire State	Includes political boundaries
Lease boundaries	Federal Lands	Nonmineral/land use leases
Land use	Federal lands	
Rights-of-Way	BLM surface	
Other		
Flood plains	Site specific	
Range IMP	BLM surface	Includes fences, water projects, etc.
Hydrography	BLM surface	Water flow and quality data
Transportation	BLM surface	BLM and County managed roads
Wilderness	Site specific	Includes designated and proposed areas
Utility corridors	Site specific	Includes pipelines, transmission lines and oil field utilities
Oil and gas wells	Entire State	Low density point data
T & E species	Entire State	Includes approximately ten species, both plant and animal
Rock, sand, gravel	BLM surface	
Groundwater flow and elevation	Entire State	
Disposal sites	Entire State	
Fire-value class	Federal lands	
Fire-problem class	Federal lands	
Fire-level of suppress.	Federal lands	
Fire-occurrence	Federal lands	
Mining claims	N/A	Not accurately georeferenced
Cliffs	N/A	Included in habitat sites
Mineral Deposits		The same as locatable/leasable minerals
Political boundaries	N/A	The same as government jurisdiction
Surface and subsurface status	N/A	The same as ownership

UTAH PLANNING SCHEDULE

Plan Name/District	Fiscal Year	85	86	87	88	89	90
Box Elder/(Salt Lake)		FEIS					
House Range/(Richfield)		MSA/AF	FEIS				
Warm Springs/(Richfield)		MSA/AF	FEIS				
San Juan/(Moab)		MSA	FEIS				
Utah CO./(Salt Lake)		INV	MSA/AF	FEIS			
San Rafael/(Moab)		PPA	INV	MSA	FEIS		
Dixie/(Cedar City)			PPA	INV	MSA	FEIS	
Escalante/(Cedar City)			PPA	INV	MSA	FEIS	
Sevier River 1/ /(Richfield)			PPA	MSA	FEIS		
Kanab/(Cedar City)				PPA	INV	MSA	FEIS
Diamond Mtn./(Vernal)				PPA	INV	MSA	FEIS
Price River/(Moab)					PPA	INV	MSA

PPA - Preplanning Analysis
INV - Inventory
MSA - Management Situation Analysis
FEIS - Final Environmental Impact Statement/Proposed Plan
AF - Alt. Formulation
1/ Amendment to be included as part of San Rafael RMP.

Appendix No. 4

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
WASHINGTON, D.C. 20240

January 4, 1983

Instruction Memorandum No. 83-220
Expires 9/30/84

To: SD's; SCD

From: Director

Subject: Display Standards for Resource Inventory Data

A. BACKGROUND

The Bureau of Land Management (BLM) regularly collects data as required by the Federal Land Policy and Management Act (FLPMA), wilderness-review, rangeland management, energy environmental impact statements, and intensive resource planning. The BLM is currently engaged in gathering data for soils, energy, minerals, vegetation, wildlife habitat, wilderness conditions, and other resources as required for land use planning and the preparation of environmental impact statements. Accordingly, there is a need to establish procedures and standards to assure accurate display and automation of the data collected for inclusion into the BLM's automated geographic information system.

The intent of this Instruction Memorandum is to identify the procedures and standards necessary to establish an accurate and consistent resource data base. It is intended also to provide a guide for resource management planning and programming. Data collected will be mapped and digitized to specific standards and procedures, and will continue to be interpreted and field-collected onto resource aerial photography. Certain requirements and conditions will necessitate a slightly different approach and these are covered in subparagraph B.1.c.

B. STANDARDS

The following standards and procedures will be followed when mapping resource data for inclusion into the BLM's automated geographic information system:

1. Map Base

   a. The standard map base for resource data collection will be 1:24,000 scale (1:25,000 metric), 7-1/2 minute USGS topographic line maps or orthophotoquads, whichever is available, except for Alaska. Orthophotoquads are recommended because of easier and more accurate transfer of resource data. For Alaska the standard base is 1:63,360, and this scale should be substituted for 1:24,000 throughout this Instruction Memorandum for applications in Alaska.

b. The following order of preference for base maps will be used:

(1) Orthophotoquad film master (1:24,000 scale).

(2) Published 7 1/2-minute topographic map film master (1:24,000 scale) or provisional map film master.

(3) 7 1/2-minute topographic map manuscript film copy (1:24,000 scale).

(4) USGS "T" Sheet (15-minute topographic map compiled at 1:24,000 scale).

(5) Quartered enlargements of 15-minute topographic maps from USGS film masters.

c. There may be some types of resource data which are better plotted to a base map larger or smaller than 1:24,000 scale. In such cases a different scale base map may be used, provided the following criteria are met:

(1) The detail and accuracy of the data warrants a larger scale base than 1:24,000.

(2) The detail and accuracy of the data does not warrant as large a scale base as 1:24,000, but in no case will it be smaller than 1:126,720.

(3) The deviation from 1:24,000 in either of the above c(1) or c(2) will require Washington Office approval.

(4) All other procedures and standards contained herein for the standard 1:24,000 scale base map will be followed.

d. The actual base product will be a stable base film (i.e. polyester or "Mylar" film materials 0.004" to 0.007" thick), reproduced from USGS masters entirely through stable reproduction procedures. Acetate, diazo film, or "Kind" paper prints are not considered stable base.

2. Resource Inventory Data Transfer Accuracy and Methods

a. Data will be transferred from photography thematic overlays keyed to the appropriate standard 7 1/2-minute map base or to the officially approved map base if the base map is at a smaller or larger scale.

b. The overlays will meet the same stable base film requirements as the base map product - polyester or "Mylar" film materials 0.004" to 0.007" thick.

c. Overlays will be accurately registered to their appropriate map bases. Punched holes in the margin ideally facilitate registration to overlays when copies are produced in the dark room. In addition, base map corner ticks and the four standard 2 1/2-minute internal ticks will be accurately registered to the appropriate map base (Enclosure 1).

d. If orthophotoquads and aerial photography are approximately the same scale, resource data may be transferred visually.

e. If aerial photography varies significantly from the orthophotoquads or only 7 1/2-minute topographic maps are available, the resource data will be transferred using the "zoom transfer scope" or similar optical device.

f. For transfer of resource data in areas of high local relief, it may be necessary to use a stereo "zoom transfer scope" or similar stereoplotter (depending on the scale and focal length of the resource photography).

3. <u>Resource Inventory Data Overlay Content</u>

a. Each overlay should address one theme only. If more than one theme is addressed on an overlay, provisions for reproduction, digitizing, and data extraction must be made. Under no circumstances should an overlay become cluttered.

b. The overlay must have the USGS quadrangle (base map) name and identification number - this number is located in the lower right-hand corner under the USGS name and is the S.E. corner coordinates of the base map. If an approved base map is at a larger scale than the 7 1/2-minute quadrangle, the portion of the 7 1/2-minute quadrangle encompassing the resource map must be identified by the appropriate latitude and longitude bounds.

c. The overlay name should be in the upper and lower right-hand corners of the collar (Enclosure 1).

d. A data block will be centered under the bar scale near the bottom of the map. The block will contain in capital letters the thematic name, method of transfer, and, as appropriate, the date of the land net and land status compilation, or collection of the resource data (Name Method Date).

Examples are as follows:

Name:	LAND NET AND STATUS	SLOPE
	SOILS	SSF
	VEGETATION (S.W.A.)	DISTANCE TO WATER

VEGETATION (WT. EST.)	PRODUCTION
VEGETATION (ETC.)	TRANSPORTATION
ALLOTMENT AND IMPROVEMENTS	WILDLIFE HABITAT (MAY REQUIRE
ACCESSIBILITY (PHYSICAL)	OVERLAYS FOR VARIOUS SPECIES)

Method of Data Transfer (Include all Base Material Used):

TO ORTHOPHOTOQUAD	TO TOPOGRAPHIC MAP
(1) Direct Visual	(4) Direct Visual
(2) Monoscopic Optical Equipment (Zoom Transfer Scope)	(5) Monoscopic Optical Equipment (Zoom Transfer Scope)
(3) Stereoscopic Equipment	(6) Stereoscopic Equipment

Dates:

1. Use compilation date for land net and land status.

2. Use date of collection (month/year) for resource data overlays.

e. Land-net and land-status mapping overlays will contain all known data pertinent to that quadrangle. Enclosure 2 identifies data to be included.

f. Standard USGS and/or BLM mapping symbols will be used on overlays except when nonexistent. New symbols must be approved by the Washington Office (200, 500, and 700) for standardization.

g. For all resource overlays a range of #00 to #0 rapidograph line weight or equivalent will be used for final drafted products.

C. An idealized mapping sequence depicting time frames for major production tasks has been developed for resource planning and programming (Enclosure 3).

Roman H. Koenings

Assistant Director, Technical Services

3 Enclosures:
- Encl. 1 - Overlay Format (1 p)
- Encl. 2 - Land-Net and Land-Status Overlay (2 pp)
- Encl. 3 - Idealized Mapping Sequence (1 p)

OVERLAY FORMAT

BEARS EARS SW
3730 N. 10952. SW
SW VEGETATION (SWA)

BEARS EARS SW
3730 N. 10952. 5W

VEGETATION SWA (1) 9/79

Encl. 1

LAND-NET AND LAND-STATUS OVERLAY

FOUND CORNERS

PROJECTED CORNERS

PROTRACTED CORNERS

BOUNDARY MONUMENTS

SECTION LINES (Solid line on USGS maps)

TWP & RNG LINES

PROJECTED SECTION LINES (Dashed line on USGS maps)

PROJECTED TWP & RNG LINES

PROTRACTED SECTION LINES

PROTRACTED TWP & RNG LINES

TWP & RANGE CALLOUTS

SECTION NUMBERS

SURFACE STATUS LINES

SURFACE STATUS SYMBOLS:

- P - Patented
- V - Public (BLM)
- NF National Park or Monument
- RW - Reclamation Withdrawl
- MW - Military Withdrawl
- IR - Indian Reservation
- WR - Wildlife Refuge or Management Area
- OF - Other Federal
- S - State
- C - County
- ROW - Fenced Right-of Way

TRIANGULATION STATIONS AND BENCH MARKS

CORNER REGISTER TICKS

DISCLAIMER STATEMENT - REFERRING TO LAND NET

BOUNDARIES -

USFS, Indian Reservation, Wildlife Refuge, National Park Service, Land Grant, State Special Areas, County, State, International

NAMES -

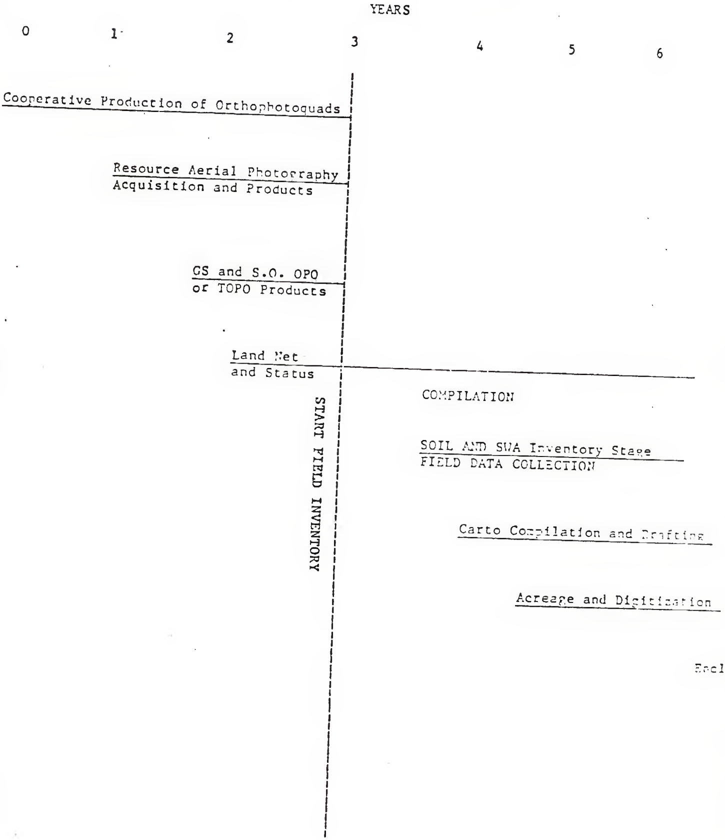
County & State Names

Selected Place Names

Road Shield and Number

Adjacent Quad Names

IDEALIZED MAPPING SEQUENCE



Encl

Appendix No. 6

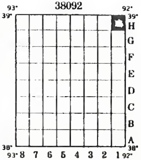
M REFERENCE CODE

U.S. Geological Survey maps are identified by name and series. In addition, a system has been initiated whereby each map is assigned a unique reference code which indicates the geographic coordinates, type, unit of measurement, and scale of map.

Various examples are illustrated at the right and a key to abbreviations is shown below.

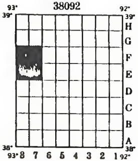
MAP TYPES

AB - Alaska Boundary Series Index
AF - Alaska Boundary Series-National Forest System
AL - Alaska Boundary Series-Bureau of Land Management System
AP - Alaska Boundary Series-National Park System
AW - Alaska Boundary Series-National Wildlife Refuge System
CF - County (feet)
CM - County (metric)
EI - Ecological Inventory
LB - Land Use and Land Cover (base)
LM - Land Use and Land Cover (multicolor)
MM - Surface Minerals Management Status
NS - National Atlas (separate sales)
OM - Orthophotomap
OQ - Orthophotoquad
PF - National Park, Monument (feet)
PL - Planimetric
PM - National Park, Monument (metric)
PR - National Park, Monument (shaded relief)
RA - Radar (airborne)
RF - Regional (feet)
RM - Regional (metric)
RP - Regional (planimetric)
RS - Radar (satellite)
SI - Satellite Imagery
SL - Slope Maps
SM - Surface Management Status
SP - State Base (planimetric)
SR - State Base (shaded relief)
ST - State Base (topographic)
TB - Topographic Bathymetric
TF - Topographic (feet)
TM - Topographic (metric)
UB - United States (base)
UG - United States (general)
UM - United States (magnetic)
UO - United States (outline)
UT - United States (topographic)
WB - World (base)
WG - World (general)
WO - World (outline)
WP - World (political)
WT - World (topographic)



INUTE SERIES

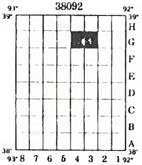
Reference Code 38092-H1-TF-024
Latitude (38°)
Longitude (92°)
Index Number (H1)
Map Type (Topographic)
Unit of Measurement (Feet)
Map Scale (1:24 000)



15 MINU RIES

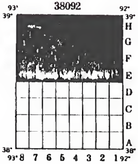
Reference Code 38092-E7-TF-062
Latitude (38°)
Longitude (92°)
Index Number (E7)
Map Type (Topographic)
Unit of Measurement (Feet)
Map Scale (1:62 500)

NOTE: A file number, also unique to each published map, is assigned for internal USGS order filling purposes.



7.5 x 15 MINUTE SERIES

Reference Code 38092-G3-TM-025
Latitude (38°)
Longitude (92°)
Index Number (G3)
Map Type (Topographic)
Unit of Measurement (Meters)
Map Scale (1:25 000)

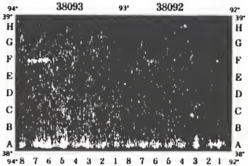


30 x 60 MINUTE SERIES

Reference Code 38092-E1-TM-100
Latitude (38°)
Longitude (92°)
Index Number (E1)
Map Type (Topographic)
Unit of Measurement (Meters)
Map Scale (1:100 000)

MAP SCALES

020-1:20 000	35M-1:3 500 000
024-1:24 000	05M-1:5 000 000
025-1:25 000	06M-1:6 000 000
050-1:50 000	07M-1:7 000 000
062-1:62 500	75M-1:7 500 000
063-1:63 360	08M-1:8 000 000
100-1:100 000	10M-1:10 000 000
250-1:250 000	11M-1:11 875 000
500-1:500 000	14M-1:14 000 000
01M-1:1 000 000	16M-1:16 500 000
02M-1:2 000 000	22M-1:22 000 000
25M-1:2 500 000	30M-1:30 000 000
31M-1:3 168 000	



1 x 2 DEGREE SERIES

Reference Code 38092-A1-TF-250
Latitude (38°)
Longitude (92°)
Index Number (A1)
Map Type (Topographic)
Unit of Measurement (Feet)
Map Scale (1:250 000)

UTAH BLM
GEOGRAPHIC INFORMATION SYSTEM

GIS PROJECT PROPOSAL

DATE:
OFFICE:
REQUESTOR:
PROJECT NAME:
STUDY AREA LOCATION:
PROJECT DESCRIPTION:

WHAT ARE YOUR GOALS/OBJECTIVES IN INITIATING THIS PROJECT?

HOW WILL USING THE GIS HELP YOU TO MEET YOUR GOALS/OBJECTIVES?

PROPOSED SCHEDULE:
Start Date: ____________
Finish Date: ____________

PROJECT MANAGER: ______________________________ PHONE No: ____________

PERSONNEL TO WORK ON PROJECT:	GIS EXPERIENCE YES	GIS EXPERIENCE NO

ANTICIPATED GIS ASSISTANCE REQUIREMENTS:

COMMENTS:

***Please complete as much of the following
(SOURCE INFORMATION)
for which you have adequate information***

UTAH B[illegible]
GEOGRAPHIC INFOR[illegible]ON SYSTEM

Date: ____________________
Office: ____________________
Field Contact: ____________________

** SOURCE INFORMATION **

NAME OF MAP: ____________________

PUBLISHER: ____________________

TYPE OF MAP: (Topo, Ortho, planimetric)

DATE OF MAP: ____________________

COMPILED: ____________________

REVISED: ____________________

FIELD COLLECTION DATE: ____________________

MAP SCALE: ____________________

MAP PROJECTION: ____________________

MEDIUM: (mylar, paper, diazo)

Was the data transferred to the digitizing base map for this project? ____yes____no

What procedures were used to transfer this data to the digitizing base map? ___Stereoscopic Equipment___Zoom Transfer Scope ___Direct Visual ___Traced

DATA USE: ____Restricted ____Proprietary
____Nonrestricted ____Non Proprietary

ORIGINAL MAP FILED AT: ____________________

DATA THEMES TO BE DIGITIZED USING THIS BASE MAP

THEME NAME	COMPILATION DATE	ATTRIBUTE CODE	DESCRIPTION

DATA THEMES CREATED

Use multiple copies as necessary*

Appendix No. 8

Glossary of Terms and Acronyms

Access The act of fetching an item from or storing an item in any computer memory device.

Accuracy The degree to which a measured value is known to approximate a given value.

Address An identification, represented by a group of symbols, that specifies a register or computer memory location.

ADS Automated Digitizing System

ADP Automatic Data Processing

Algorithm A finite set of instructions which, if followed, accomplish a particular task.

Alphanumeric A set of characters with letters, numbers, punctuation marks, and special symbols.

AMS Automated Mapping System

AO Area Office

AOS Advanced Operating System

APD Application for Permit to Drill

Assembler A computer program that translates instructions written in a source language directly into machine language.

Auxiliary Memory Any computer memory or memories used to supplement main memory.

AWP Annual Work Plan

Batch Processing A method in which a number of data items or transactions are coded and collected into groups and processed sequentially.

BIA Bureau of Indian Affairs

Bit Acronym for Binary Digit, the smallest unit of information which can be stored in the computer.

BLM Bureau of Land Management

Boundary General term for the division between two mapped areas.

BPI Bits Per Inch

Buffer	The internal portion of a data processing system which serves as an intermediate storage between two different storage or data handling systems with different access times or formats.
Byte	A group of adjunct bits that are operated on as one unit.
Card Image	A representation in computer storage of the hole patterns of a punched card. The holes are represented by one binary digit and the spaces are represented by the other binary digit.
Cathode Ray Tube (CRT)	An electronic tube with a screen that is used in computer terminals to display input and output data. Also referred to as a CRT.
Cell	The smallest region in a grid.
Central Processing Unit	The central processing unit, or CPU, of the computer is that portion of the computer which is used to control the components of the hardware system.
Centroid	The center point of a mass or polygon.
Chain	A synonym for a string, e.g., "a chain of coordinates."
Character	A letter, digit, or other special symbol used for the representation of information.
Compiler	A computer program that converts a source language into an object language.
Coordinate	A ordered set of values that specify a location.
Core	The most accessible information storage of a computer.
COS	Cartographic Output System
Cursor	A movable part of an instrument that indicates (x,y) coordinates to the machine.
Data Base	A set of data files organized in such a manner that retrieval and updating can be done on a selective basis and in an efficient manner.
DBMS	Data Base Management System
Data Structure	The arrangement and interrelationship of data.
Data Tablet	A flat tablet which will output the digital position of a pointer placed at any position on its surface.
DEM	Digital Elevation Model

Digitization	The process of converting analogue or graphic data into digital form. Manual digitization involves the transformation of data by an operator with or without mechanical computer processors, while automatic digitization requires the use of an automatic device, i.e., scanner, pattern recognition, character recognition.
Digitizer	A device which converts maps into a digital format for computer input.
Direct Access	Interactive systems employ direct or random access in which the access time is not related to the location of the data in the computer memory, i.e., data does not have to be serially or sequentially searched.
DLG	Digital Line Graph
DO	District Office
DOE	Department of Energy
DOI	Department of Interior
DSC	Denver Service Center
EA	Environmental Assessment
Editing	The detection and correction of errors.
Encode	The process of applying a set of unambiguous rules to transform data from its original form to some coded representation, usually digital.
Field	A group of characters that is treated as a unit of data.
File	A variable number of records grouped together and treated as a main division of data.
FY	Fiscal Year
Fixed Length Record	Relates to a number in which various records must contain the same number of characters.
Format	The specific arrangement of data in a record or file.
FORTRAN	An acronym for FORmula TRANslation, a procedure-oriented computer programming language.
GB	Giga Byte
Geocoding	The geographic coding of the location of data items.

Geographic Base File	A coded network.
Geographic Coordinates	A spherical coordinate system for defining the position of points on the earth.
GIS	Geographic Information System
Geo-referencing System	Planimetric coordinate system which identifies points on the surface of the earth. Systems include latitude-longitude, universal transverse mercator, stable plane coordinate and land survey systems, etc.
Grid Coordinates	Euclidean coordinate system in which points are described by perpendicular distances from an arbitrary origin, usually on an (x,y) axis.
Hardware	The physical components of a computer and its peripheral equipment.
Hard Copy	Printed or paper copy of computer output. Commonly a paper copy of the information displayed on a computer video terminal.
IDIMS	Interactive Digital Image Manipulation System
IM	Instruction Memorandum
Information Retrieval	Methods and procedures used for storing and retrieving specific data and/or references based on the information content of documents.
Interactive Mode	Allows users to directly interact with the information system to input and/or manipulate and retrieve information in a real time framework.
Interface	The junction between components of a data processing system.
Intersection	The region containing all of the points common to two or more regions or polygons. See also union.
I/O	Input/Output
KB	Kilo Byte
KGS	Known Geologic Structure
Light Pen	A device the size of a ballpoint pen which is used for pointing to a location on a CRT screen. One of several types of interactive positioning devices include a mouse, joystick, and tracking ball.

Line Printer An output device for computers which prints one line at a time. It can be used as a high speed listing or, by spacing symbols, as a plotting device.

LPM Lines Per Minute

Machine Language Instructions written in a code that can be understood by the computer without further translation.

Magnetic Disk A computer memory device on which data is available by random access.

Magnetic Tape A computer memory or storage device which will store a large amount of data, but this data is only accessible in a sequential search.

MB Mega Bytes

Memory An organization of storage units (bits, bytes) retained primarily for information retrieval.

Minicomputer An inexpensive CPU with limited core capacity.

MOSS Map Overlay Statistical System

Natural Language A user-oriented language which can be used to search the computer files by operators who have no programming experience.

NEPA National Environmental Policy Act.

Network A connected set of segments and nodes.

Node A point which is common to two or more segments.

Object Language A machine language that is output from a compiler.

Off-line Processing is not directly under the control of the central processing unit.

On-line Processing is directly under the control of the central processing unit. All interactive systems operate on-line.

Optical Character Recognition The process by which printed characters are read by light sensitive devices for computer input. Also referred to as OCR.

OS Operating System

Overlay The superimposition of one map or digital image over another of the same area in order to determine data combinations or intersections and unions.

PEC	Planning and Environmental Coordination
Peripheral	Input and output equipment used to transmit data to and receive data from a CPU.
PL/1	A computer language intended to combine the most useful features of the scientific (FORTRAN) and business (COBOL) languages.
Plotter (line)	A mechanical plotter controlled by a computer, generally for the recording of location or spatial information. Lines are drawn as a series of vectors, usually by pens. Scribing tools and photoheads are also available as accessories.
Plotter (raster)	A plotter which prints an array of tiny dots to draw the material being plotted. Device is usually electrostatic (xerox principle), although systems using ink jet technology are also available.
Polygon	Plane figure consisting of three or more vertices (points) connected by line segments or sides.
Program	The implementation of a procedure by the use of a computer programming language. A program consists of a set of instructions which direct the CPU in the performance of a specific task.
Random Access	The process of obtaining information or data from a computer storage device where the time required for such access is independent of the location of the information most recently obtained.
Raster Scan	A line-by-line sweep across a display surface to generate or record an image.
Real Time	Processing which appears instantaneous to the person or the device controlling a computation.
Remote Sensing	The acquisition of information without physical contact. Includes visual, photographic, and electronic data-gathering methods.
Resolution	Measure of the ability of an imaging system to separate the images of closely adjacent objects. Also, the smallest area at which data can accurately be identified.
RMP	Resource Management Plan
SCS	Soil Conservation Service
SO	State Office

Software	The set of programs used to instruct the computer in problem solving; consists of the operating system programs and applications programs.
SOP	Standard Operating Procedure
Spatial	Referring to a phenomenon distributed in space and, therefore, having physical dimensions.
String	A consecutive sequence of characters.
Terminal	A device used to input or output data from a computer, often from remote sites.
Time Sharing	A concurrent use of a computer system by more than one user or program by allocating short time intervals of processing to each active user. The response time is usually so fast that each user is given the impression that the computer's resources are totally designated to his task.
Uniform Grid	Square, rectangular, or hexagonal lattice grid coordinate system for recording geographic data.
Union	The region containing all of the points in two or more regions or polygons. See also intersection.
USFWS	U.S. Fish and Wildlife Service
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USO	Utah State Office
Variable length	Relates to a file in which the various records may contain a different number of characters.
VDT	Video Display Terminal
VS	Virtual System
WELUT	Western Energy and Land Use Team
WM	Work Month
WO	Washington Office

BLM COMM UTAH Data System